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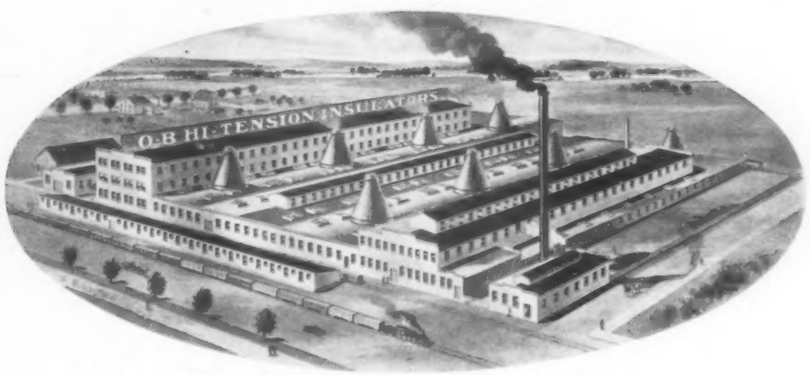
Service Efficiency of O-B Insulators



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The Journal of Electricity, Power and Gas

AGAIN IN ITS OLD HOME

The Heart of the Electrical, Power and Steel Industries of San Francisco

List of Companies Occupying Offices October 1, 1911

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JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVII SAN FRANCISCO, SEPTEMBER 30, 1911 NUMBER 14

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THE BIG MEADOWS DAM

In constructing the Big Meadows dam, the Great Western Power Company will place before engineers and investors a very interesting piece of work. This dam when completed will back up the flood waters of the Sierras, submerging 25,600 acres of land, thereby impounding 1,160,000 acre ft. of water. It will be 720 ft. long on top and 150 ft. high over all. By the employment of the Eastwood Multiple Arch type less than 30,000 cu. yds. of reinforced concrete will be necessary in its construction.

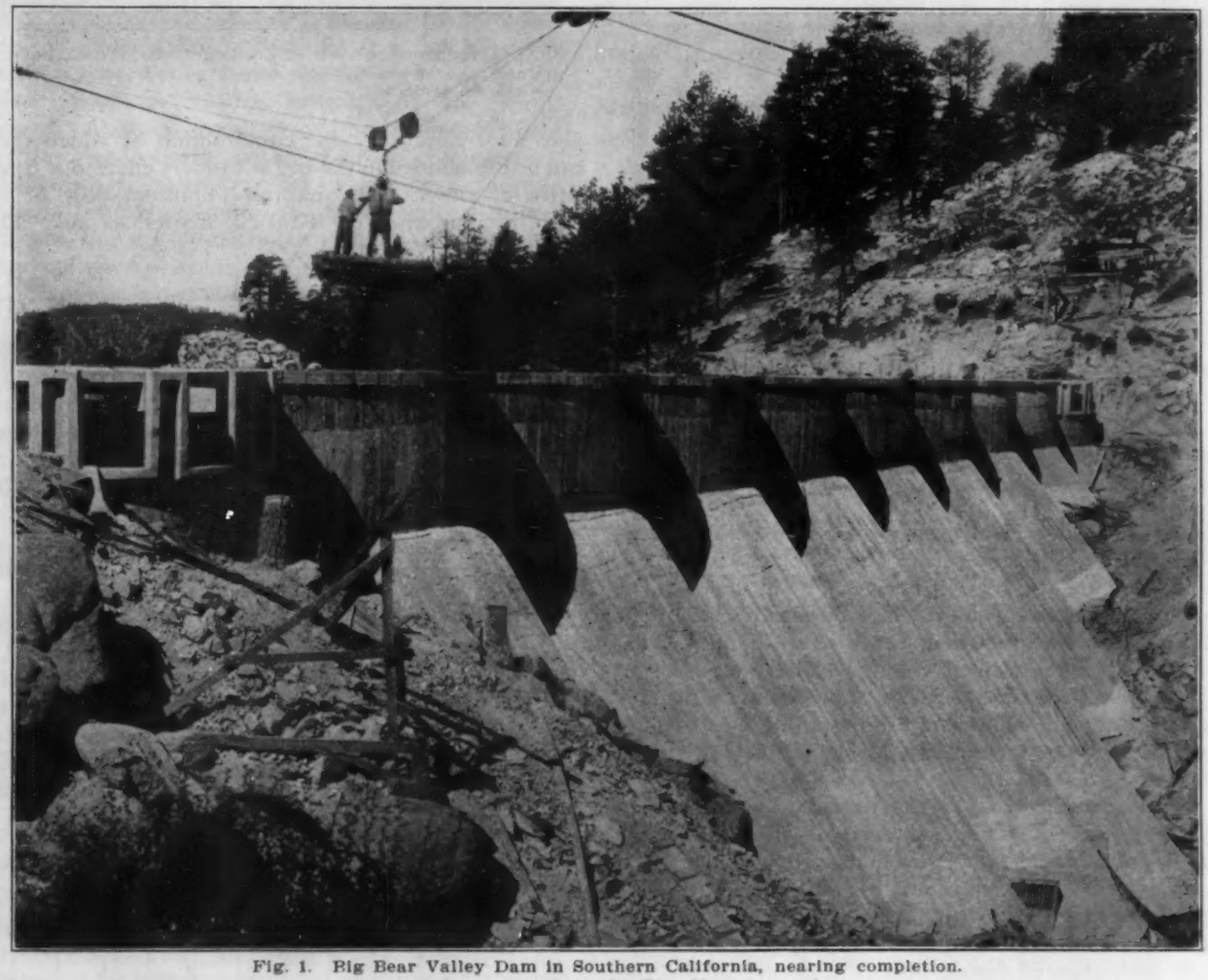

Fig. 1. Big Bear Valley Dam in Southern California, nearing completion. Type of dam adopted in the Big Meadows project.

It is interesting to compare this dam with other similar reservoir dams. There are but three that can be put in the same class. These are the Ashokan, the Roosevelt and the Assouan dams. The Ashokan dam of the New York water supply submerges 8300 acres of land, thereby impounding 368,030 acre feet of water. The dam is 1000 ft. long on top and 180 ft. high; 884,000 cu. yds. of masonry and 7,000,000 cu. yds. of earth work were necessary in its construction and its cost was $12,669,755. The Roosevelt dam of the

U. S. Reclamation Service submerges 16,320 acres of land, thereby impounding 1,284,000 acre feet of water. The dam is 1080 ft. long on top and 280 ft. high; 332,300 cu. yds. of material were necessary in its construction and its cost was $3,470,000. The Assovan dam in Egypt was first built to submerge 40,000 acres of land thereby impounding 863,000 acre ft. of water. The original length was 6400 ft. and height 130 ft., necessitating 700,000 cu. yds. of masonry at a cost of $12,250,000. It has since been increased to 1,500,000 acre ft., but the final cost and dimensions are not available.

The present project for the building of the Big Meadows dam produces the cheapest reservoiring per acre ft. of any project of its size in the world. The comparative small amount of concrete (30,000 yards) is due in a great measure to the natural endowments of the dam-site. In Fig. 2, as one looks down stream, the cleared portion is the location decided upon. Nevertheless a saving of $500,000 is made by the particular design of dam selected over a cyclopean masonry

Fig. 2. Damsite at Big Meadows, Looking Down Stream.

dam. The dam-site is located one mile below Nevis, Plumas county, California. The dam will be 150 ft. high over all, the burden being 34 ft. in depth. The bed-rock formation is a gray lava or basaltic rock. The drainage area from which the waters to fill the enclosure will be drained comprises 480 sq. miles of the snow-capped Sierras. It is now definitely planned to have the dam completed by the fall of 1912 so as to benefit by its water storage during the dry season of 1913.

The dam is to be of the Eastwood multiple-arch type. John S. Eastwood, the originator of the design employed is to be the engineer in charge. There will be 22 spans of 30 ft. each, and in addition an automatic spillway constructed with straight walls and a concrete apron. Fig. 3 shows the skeleton of an Eastwood multiple arch type of dam. This is a picture of the Big Bear Valley dam near Redlands, California, now in course of erection. Fig. 1 shows the same dam almost complete. This dam which has thus far proved thoroughly satisfactory although as yet not fully tested is 92 ft. over all in height, 363 ft. long. It contains 4684 cu. yds. of material and impounds 63,000 acre ft. of water.

The North Fork of the Feather River has its source in springs rising in the Big Meadows. It flows out of the Meadows through a narrow gorge which provides a natural and inexpensive site as detailed

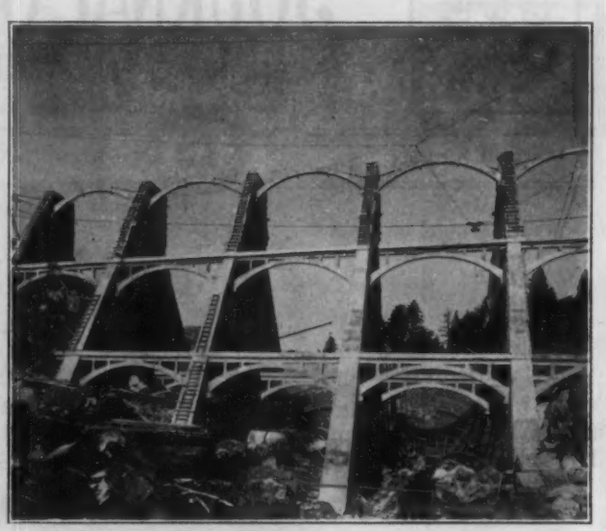

Fig. 3. Skeleton view of Big Bear Valley Dam, illustrating Eastwood Multiple Arch Type to be used in Big Meadows project.

above for a dam by the construction of which there can be impounded in the Big Meadows enormous quantities of water. The natural minimum flow of the river is approximately 1000 cu. ft. per second. This

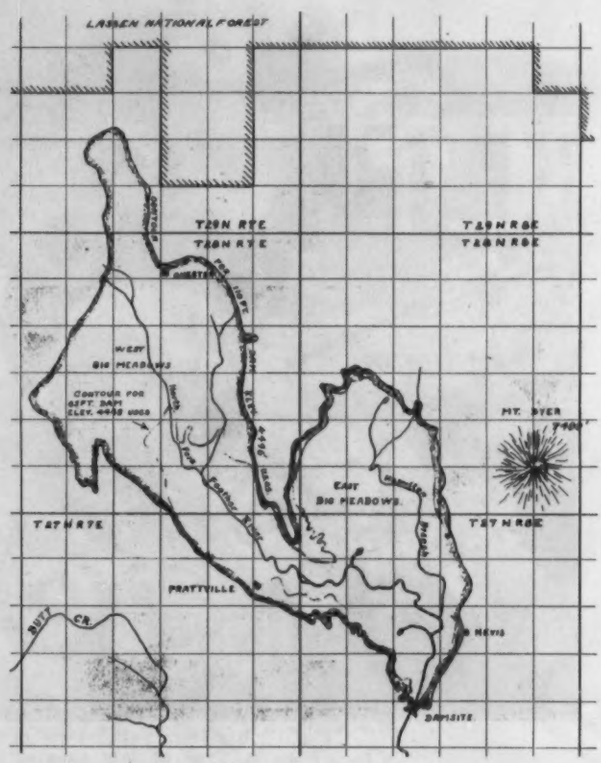

Fig. 4. Area to Be Flooded by Waters Impounded in Big Meadows When Dam is Completed.

flow will be increased to 1500 cu. ft. per second as the result of the construction of a 63 ft. dam, and 2500 cu. ft. per second when the dam is raised to its full height of 110 feet as contemplated.

The combined minimum flows of all the rivers upon which power is now being developed to supply Oakland and the territory east and north to Oroville do not exceed that of the North Fork of the Feather River. The storage possibilities on these several streams do not equal that of the Big Meadows alone. The by-product value for irrigation of the waters stored in the meadows after they have been converted into electric energy is sufficiently great to warrant the belief that in time substantial revenue to the company will accrue from this as yet little considered source.

At Big Bend, eighteen miles above Oroville, and one hundred and fifty-three miles northeast of Oakland, the company has installed in successful operation a hydroelectric plant with a total capacity of 55,000 electrical horsepower which will be increased in the near future to 70,000 horsepower. This plant consists of a masonry dam 85 ft. high and a concrete intake tower through which the water is delivered under pressure to a concrete lined tunnel driven through the solid rock for 15,000 ft., from which it passes by means of a steel header and pressure pipes to four water wheels directly connected to electric generators. The water is utilized under a head of 455 ft. at which head the natural minimum flow of the river is sufficient for the present installation. When the flow of the river is increased to 2500 cu. ft. per second by the development of the Big Meadows storage, this plant can be increased to 110,000 electrical horsepower by merely adding the necessary generating units, the intake tower, tunnel, and header having been constructed of sufficient size to accomplish this result.

The power generated at Big Bend is transmitted 153 miles to Oakland over two circuits, each consisting of three copper cables suspended from steel towers set in concrete foundations. The power, which is transmitted at 100,000 volts, is reduced to make it available for commercial use by means of apparatus installed for that purpose in concrete substations located at Sacramento, Brighton, Antioch, Cowell and Oakland. From these substations secondary distributing circuits carry the current to the customers of the company. Each substation can, through its secondary distributing system, supply customers within a radius of twenty-five miles.

Between the Big Meadows and the present plant at Big Bend, the North Fork of the Feather River has a fall of 3400 feet, much of which can be used for power purposes. The opportunities for the profitable use of this fall are practically all controlled by the company. With the amount of water which will be made available by the Big Meadows storage these developments will, it is estimated, produce 500,000 horsepower.

On the estuary in Oakland, an unusually favorable location for securing condensing water and supplies of fuel oil by barge, pipe line or railroad, the company has erected a concrete and steel power plant containing water tube boilers and three steam turbines each directly connected to electric generators of a combined capacity of 15,000 electrical horsepower. This plant is in reserve for emergencies and as an assurance to customers of continous service.

The steam plant in San Francisco consists of a steel and concrete building, water tube boilers having a capacity of 20,000 horsepower and steam turbines directly connected to electric generators having a capacity of 28,000 electrical horsepower. Additional boiler capacity can be installed in the present building. From this power station, by means of conduits in the business district, and over head lines in the residence sections, the company supplies a large amount of current for lighting and power in San Francisco.

Physical connections between the plants in San Francisco and Oakland will in a few months be effected by means of cables under the Bay of San Francisco. This will make it possible to use in San Francisco the low cost hydroelectric current generated in the mountains at a very substantial saving over that generated by steam from fuel oil. It also makes available, as a reserve for the entire system, the steam plant in San Francisco which can now be used only for that district. The combined capacity of the power plants now in operation is 98,000 electrical horsepower.

The Great Western Power Company, the owner of these properties, has had an interesting history. It had its inception in 1900 and after six years devoted to the acquisition of lands and water rights and preliminary engineering and investigation, was incorporated in 1906. Construction of its power plant at Big Bend was started the same year, continued without interruption during the panic of 1907, and was completed in 1909. The company has been in successful commercial operation for eighteen months. In 1908 the California Electric Generating Company, a subsidiary of the Great Western Power Company, completed its steam plant in Oakland, it having been erected as a reserve to the hydroelectric plant. The company has but recently taken over the City Electric Company of San Francisco by purchase of its capital stock. The plant of the City Electric Company in San Francisco was completed in November, 1907, and has since been in continuous operation.

The Great Western Power System, which term is used to designate the property of the company and its subsidiaries, including the City Electric Company, consists of hydroelectric properties on the North Fork of the Feather River in California; a steel tower transmission line from the Big Bend power plant to Oakland; substations at Sacramento, Brighton, Antioch, Cowell and Oakland and secondary distributing lines radiating therefrom, and underground and overhead distributing systems in San Francisco, a steam plant in Oakland and one in San Francisco.

ELECTRICITY IN AGRICULTURE.

So far as wheat is concerned the beneficial effect of electricity has been amply demonstrated by experiments already carried out. With three different fields of wheat, each growing electrified and non-electrified crops, so distinct was the improvement in the electrified crop that a line of demarcation in the field could be plainly seen. Satisfactory experiments have also been tried here upon sugar beet. In Germany experiments have been carried out with an electrified spray of water in order to get over a difficulty which has been encountered, namely, that electrified crops produce less in dry weather.

PRIMER OF APPLIED THERMODYNAMICS.[1] FIFTH LECTURE.

Laws of So-called Perfect Gases.

During the last lecture the results of applying heat to a pound of ice at 0° F. until it was finally evaporated into steam was followed step by step. As long as any water remains, the steam or gas being formed has peculiar properties as compared with the steam or gas when its temperature is raised considerably beyond the evaporation point for the particular pressure at which the evaporation of water in steam takes place by a slight increase in heat, or what is practically the same thing the condensation of steam back into water by a slight decrease of heat. Where steam is thus heated beyond its condensation point, it is said to be superheated, and like all other gases heated beyond their condensation point, it obeys almost perfect laws, which are known as laws of perfect gases. Among the socalled perfect gases may be classified air, hydrogen, oxygen, superheated steam, ammonia, carbonic acid, and a number of others.

Years ago a scientist named Boyle took an enclosed tube of the form A B C D E, and put one of the socalled perfect gases in D E and then poured mercury B C D, into the tube, thus compressing the gas in D E. Now it is evident that the weight of the column of mercury BC, added to the atmospheric pressure will give at once the total pressure on the gas in D E. By pouring in more mercury at A, Boyle

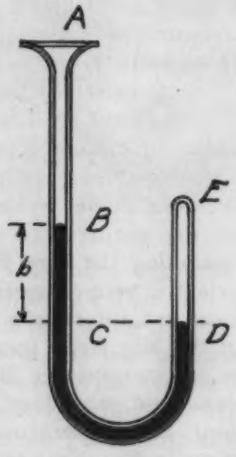

Fig. 15. Boyle's Experiment in Establishing His Law of Gases.

found a wonderful relation which is still known as Boyle's Law of Gases. He found that as the pressure was increased the volume of the gas diminished, and in such a way that the product of the pressure and volume always remained constant. Thus, if the volume was 2 cu. in. at 14.7 lb. pressure, it would be reduced to 1 cu. in. by application of 29.4 lb. pressure.

Putting this law into algebraic form we have

$$p\,v = \text{a constant},$$

$$\text{or } p\,v = p_0\,v_0,$$

where p = pressure per square foot,
v = cubuc feet per pound,
p_0 = pressure per square foot, usually at 32° F.,
v_0 = cubuc feet per pound, usually at 32° F.

In 1806 Charles found another very remarkable law of gases. He found that by keeping a gas under a constant pressure and applying heat, a definite increase in volume would result. Now Charles found definitely that if, for instance, he started with a gas at 0° C., no matter what the pressure as long as he maintained it constant throughout his experiment, when he had applied sufficient heat to raise its temperature to 1° C., the gas had increased 1/273rd of its volume. Expressed mathematically, this becomes

$$v = v_0\,(1 + t/273)$$

where v = cubic ft. per pound of gas,
v_0 = cubic ft. per pound of gas at 0° C.,
t = degrees centigrade.

By observing this equation, we see that if a gas be cooled, there would be a point where its volume would be practically nothing. Such a point would be reached at — 273° C. or 491.4° F. below the freezing point of water. Now since the freezing point of water is 32° on the Fahrenheit scale, to convert temperatures to absolute Fahrenheit scale, we must add 459.°4 to the number of degrees Fahrenheit, and to convert temperatures to the absolute Centigrade scale, 273° to the number of degrees Centigrade.

It will be evidently a matter of great convenience in computation, and in the study of gases, if a single equation is devised that will represent both these laws above stated.

Such an equation is

$$pv = R\,T,$$

where p = the number of lb. per sq. ft.,
v = the cu. ft. per lb.,
R = a constant,
T = degrees Fahrenheit on absolute scale.

Evidently from this equation we can find the value of R for any perfect gas if we know its volume at any given temperature and pressure, and having once determined its value, ever afterwards any pressure or any volume, or any temperature can at once be computed when two of these factors are known.

In the case of air and its application in the air compressor, we know that one lb. of air has a volume of 12.39 cu. ft. under atmospheric pressure of 32° F. Now as we have previously seen, atmospheric pressure amounts to 14.7 lb. per square inch. In our formula this pressure must be multiplied by 144 in order to compute the pressure per sq. ft., and as 32° F. is equal to 491.°4 F. in the absolute temperature, we now substitute in our formula

$$p\,v = R\,T$$

$$(14.7 \times 144) \times 12.29 = R\ (491.4)$$

$$\text{or } R = 53.37.$$

Hence for air we have

$$p\,v = R\,T,$$

$$\text{or } p\,v = 53.37\ T.$$

This equation is always true for air, hence let us take a practical computation. In an air compressor chamber we have 10 lb. of air at 200° F. The cubical contents of the chamber amount to 120 cu. ft. What must be the pressure?

[1] A resume, devoid of higher mathematics, covering the essentials of a series of lectures now being given by the editor of this Journal before the Senior Mechanical Engineering students at the University of California.

$$T = 459.4 + 200 = 659.4 \quad v = \frac{120}{10} = 12$$

hence— $$p = \frac{53.37 \times 659.4}{12} = 2950 \text{ lb. per sq. ft.}$$

In the solution of problems such as this, the slide rule is found most convenient and the result is probably correct within 2 per cent.

Taking another illustration, how many pounds of air does it take to fill 5600 cu. ft. at 15 lb. pressure per sq. in. and at 60° F?

Here $p = 15 \times 144$; $T = 459.4 + 60 = 519.4$,

$v = \frac{519.4 \times 53.37}{15 \times 144} = 12.9$, and as this is the volume of 1 lb., 5600 cu. ft contain $\frac{5600}{12.9} = 434$ lb. of air.

It is evident that if we can introduce into our general equation some slight modification in order to obtain weights directly, it will be a little more convenient in the solution of such problems as the above.

Let V = total cu. ft. of a gas.
v = cu. ft, per lb.
W = weight in lb.

Then $W \times v = V$

$$\text{or } v = \frac{V}{W}$$

Substituting in our formula,

$$p\,v = R\,T,$$

$$\text{we have } p\frac{V}{W} = R\,T,$$

$$\text{or } W = \frac{p\,V}{R\,T}$$

In the last problem, above mentioned, we can now substitute and solve directly; thus:

$$W = \frac{p\,V}{R\,T} = \frac{15 \times 144 \times 5600}{53.37 \times 519.4} = 434 \text{ lb. of air.}$$

Having now determined a definite value of "R" in the case of air, we shall next discuss an accurate and beautiful method of determining its value for any other perfect gas, by simply knowing its specific density. Before, however, illustrating this method, it will be instructive to discuss one more law of gases. Dalton, in 1807, gave forth to the world the law of partial pressures, summarized in the following sentences. Two gases at the same temperature, provided they do not interact chemically, do not interfere with each other's pressures when mixed. Thus, if they are forced into the same volume, the pressure of the mixture is equal to the sum of those of the components. The gases are, therefore, still thought of individually, and the share which each gas has in the total pressure is called its partial pressure. For example, a gas measured over water contains water vapor. The partial pressure of this, called the aqueous tension, which is definite for each temperature, must be substracted from the total pressure.

Now if the gases do act upon one another chemically, we must very carefully consider the new relationship. The difference in the two cases can be better seen from a comparison by illustration. First take air as an example of a mixture of two gases. As we have previously seen, air contains four parts by volume of an inert substance known as nitrogen and one part by volume known as oxygen. Each part of nitrogen has 14 units of weight as compared to 16 units of weight for each part of oxygen. Placing these 5 parts together we should have a total of 72 units of weight, which would occupy 5 units of volume. Then evidently 1 unit of volume of air would have 14.4 units of weight. Oxygen gas has 16 units of weight as we have just seen. In our formula $p\,v = R\,T$, which we have found true for all perfect gases, it is clear that if we are considering a gas that is, for instance, twice as heavy as air, v would be but one-half, and consequently R would have to be but one-half. Hence to compute R in any given case, since we know R for air, we have a simple relationship, that the R for the new gas is to the R for air as the relative density of the air is to the relative density of the new gas. Thus to find R for oxygen, we have

$$\frac{R_o}{R_a} = \frac{14.4}{16}$$

$$\text{or } R_o = \frac{53.37 \times 14.4}{16} = 48.1$$

To compute the relative density of a mixture of two gases which have undergone a chemical change, we must proceed very carefully, taking into account the laws of chemical reaction. Let us take the case of superheated steam, or H_2O, which means that 2 units by volume of hydrogen have been mixed and chemical reaction taken place with 1 unit by volume of oxygen. If no chemical reaction had taken place, we should proceed to compute its relative density exactly as in the case of air. Thus we should take two units of volume of the hydrogen, which represents two units of weight also, and add one unit of oxygen, which represents 16 units of weight, thus making 3 units of volume, in all, representing 18 units of weight. Hence 1 unit of volume would represent 6 units of weight. This is incorrect, however, as chemical action has taken place, and the two hydrogen units have combined with the one unit of oxygen to form steam or H_2O. It is found by experiment that the volume occupied by the new compound is twice as much as the oxygen under the same condition of pressure and temperature. Hence the weight of the new compound or rather density is one-half of the 18 units above referred to or in this case 9. Therefore to compute R for steam, we have

$$\frac{R \text{ (steam)}}{R \text{ (air)}} = \frac{14.4}{9}$$

$$\text{or R (steam)} = \frac{53.37 \times 14.4}{9} = 85.6$$

Similarly for other gases, we find values in the following table:

	Relative Density.	R Value.
Air	14.4	53.4
O	16.	48.1
H	1.	770.
N	14.	54.9
CO_2	22.	35.
NH_3	8.5	90.6
CO	14.	54.9
H_2O (steam)	9.	85.6

We must observe caution in using too freely the above formulas, for at our ordinary pressures and temperatures, the gas may be too near its condensation point, and we shall find that the law for perfect gases will not hold when a gas becomes a saturated vapor or even too near this point. With proper discretion in their use, however, the above will be found sufficiently accurate for their ordinary application.

THERMOTWISTERS.

1. Find the volume of one pound of air in an air compressor at a pressure of 100 lb. per sq. in., the temperature being 32° F., using Boyle's law only.

2. From Charles' law, find the volume of one pound of air at atmospheric pressure and 72° F.

3. Find the temperature of 2 ounces of hydrogen contained in a 1-gallon flash and exerting a pressure of 10,000 lb. per sq. in.

4. How large a flask will contain 1 lb. of nitrogen at 3200 lb. pressure per sq. in. and 70° F?

SOLUTION OF THERMOTWISTERS—SECOND LECTURE

1. Convince yourself of the enormous amount of latent energy stored in 10 lb. of coal. Assume that each lb. of coal has a calorific value of 14,500 B.t.u. Convert into mechanical energy and estimate the vertical aerial journey you could take on this energy, were it exploded under you and your body were able to absorb all the energy.

Total calorific value of coal.

$$= 10 \times 14{,}500 = 145{,}000 \text{ B.t.u.}$$

$145{,}000 \times 778 = 112{,}800{,}000$ ft. lbs., of energy represented.

Assuming my weight at 175 lb., it would require 175 ft. lb. to lift me 1 ft. Hence I would be lifted a total distance of

$$\frac{145{,}000 \times 778}{175} = 644{,}500 \text{ ft. Ans.}$$

or about 123 miles.

2. In a heat engine test, each pound of steam leaves the engine containing 125.2 B.t.u. less heat than when it entered the cylinder. The engine develops 155 h.p., and consumes 3160 lb. of steam per hour. Compute the mechanical equivalent of heat.

$$155 \text{ h.p.} = 155 \times 33{,}000 \times 60 \text{ ft. lbs. per hour.}$$

Since 125.2 B.t.u. leave each lb. of steam for a total of 3160 lb., we have

$$3160 \times 125.2$$

Hence mechanical equivalent of heat

$$= \frac{155 \times 33{,}000 \times 60}{3160 \times 125.2} = 775 \text{ Ans.}$$

3. In a test to determine the calorific value of anthracite coal by means of a Parr Calorimeter, ½ gram of the coal was properly burned and a temperature rise of 2.040° C noted. How many B.t.u. of heat per lb. of coal?

On page 228, we find

$$C = (t - 0.006°) \times W \times 0.73$$

Since $W = 2$ kilograms we have

$C = (2.040 - 0.006) \times 2 \times 0.73$ calories per ½ grm. of fuel.

or $2.034 \times 2 \times 0.73 \times 2000$ calories per kilogram of fuel.

Since 1° C. = 9/5° F. and 1 kilogram = 2.205 lb., we have

$$\text{B.t.u. per lb of fuel} = \frac{2.034 \times 2 \times 0.73 \times 2000}{2.205} \times 9/5 = 4850. \text{ Ans.}$$

4. A piece of cast iron bar, weighing one-half lb., is thrown into the furnace and heated to the temperature of the fire, and is then withdrawn and placed in a pail containing 10 lb. of water. The original temperature of the water was 60° F., and after immersion of the iron, the temperature rose 20°. Find temperature of the furnace.

On page 227 we find specific heat of cast iron is .180.

$$X = T + \frac{W\,t}{W\,S}$$

$$\text{or } X = 60 + \frac{10 \times 20}{0.5 \times .180} = 60 + 2224 \text{ or } 2284° \text{ F. Ans.}$$

INTERURBAN RATE MATTERS IN THE NORTHWEST.

The supreme court of the State of Washington has recently handed down a most important decision relative to the rate struggle of electric railways operating in suburbs of Tacoma and Seattle. The case in question being that of the Puget Sound Electric Railway Company, appellant, against the railroad commission of Washington ex rel W. H. Paulhamus, respondent, and David Hart and others, intervenors, sustaining the Thurston county superior court in upholding the order of the railroad commission which reduces the rates on the interurban between Seattle and Tacoma for a distance of twelve miles out of each city, and which cuts the rates on the Seattle-Renton line and the Tacoma-Puyallup line.

The first rates were established when the company started business in 1902, and they prevailed until October 17, 1909, when the company put in its new rates, which resulted in almost depopulating the smaller suburbs, which were inhabited by the workers of Seattle and Tacoma, who had acquired land for small homes because of the low rates. It was shown

Limited Train, Puget Sound Electric Railroad. This is the road the new rate decision will directly affect.

that they could not afford to pay the new rate, therefore the commission held it was unreasonable.

Chairman H. A. Fairchild, of the commission, declares that the decision is the most important that has ever been made in the Washington court on the subject of rate making

The court takes the same view the commission does: That 7 per cent is not an unreasonable return on an investment; that mistakes of the company in the past cannot be assessed to the traveling public (for it was shown that since being organized the company has not set aside a proper sum to cover depreciation).

"The importance of the decision is not measured by the relief granted to the patrons of this road," says Mr. Fairchild. "It is in the principles enunciated, which will be authoritative in the determination of future rate hearings.

"The court, in an exhaustive review, sustains the commission in its holding that the maximum charge that can be made by a public service company is the value of the service to the patron (provided the charge pays the cost of the extra service rendered) irrespective of whether the particular charge will be remunerative to the stockholders.

"The railroad company contended that, while it might properly voluntarily reduce the charge for a particular service to a point that was not compensatory, the commission possessed no such authority and must be guided solely by a consideration whether the rate was remunerative; that this was a question of policy, and when the commission ordered in a rate that, standing alone, was an unremunerative rate, it usurped the functions reserved to the company.

"The effect of the decision is to permit the commission in dealing with particular rates to consider all the elements and surroundings that would influence an honest traffic manager in putting in or changing such rate.

"Many questions affecting valuation of railroads are settled by the decision. From a commission standpoint, it is the most important decision handed down by our courts.

"In my opinion, the order affirmed will result in an increase of net returns to the company. The rates ordered reduced affect only approximately 10 per cent of the company's revenues, and the increase in travel by reason of the reduced rates will, in my judgment, result in a benefit instead of an injury to the railroad company."

ELECTRICAL JOBBERS AT PORTLAND.

The Pacific Coast electrical jobbers met at Portland, Oregon, on September 21, 22 and 23. They played some golf, saw some baseball and heard some papers. The golf tournament was won by R. D. Holabird, who still holds the cup. The baseball was of the professional series which is not yet completed. The papers will appear in subsequent issues of this publication.

The papers read and discussed included "Cost of Doing an Electrical Supply Business," by R. D. Holabird of San Francisco; "What Should Constitute Assets of a Company," by R. H. Gregory comptroller of the Western Electric Company, and "How to Overcome the Practice of Selling Staple Commodities at a Loss," by F. M. Bernadin.

At the banquet on Friday evening a number of manufacturers' representatives also joined the party, having been invited to be in Portland at the time. These included S. D. Vandergrift of the National Electric Lamp Association; H. E. Sanderson of the Bryant Electric Company; Irving H. Shorno of the General Electric Company; Henry R. Behneman, manager of John R. Cole Company's Seattle house; A. E. Barlow and C. E. Johnson of the American Ever Ready Company; C. E. Gregory of the Arrow Electric Company; F. G. Larkin, Seattle representative of the Telephone Electric Equipment Company, and M. D. Stearns of the Standard Underground Cable Company.

The meeting was unanimously declared to be one of the most successful yet held, being characterized by an excellent spirit of co-operation in electrical trade circles on the Pacific Coast. Portland's beauties of climate and scenery were fully enjoyed especially by those participating in the golf tournament at the Waverly Golf Club.

The formal meeting adjourned at noon on Saturday, some leaving for San Francisco and some for Seattle later in the day, others staying to enjoy the hearty hospitality of the web-footers.

SEATTLE BRANCH MEETING OF AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The members of the Seattle Section of the American Institute of Electrical Engineers met at dinner at the Arctic Club on the evening of September 16. This being the first meeting after the summer recess no formal paper was presented. Secretary Whitney reported the business transacted at the Chicago national meeting and Chairman A. A. Miller outlined a comprehensive plan of action for the next year. In all likelihood a Pacific Coast meeting will be held at Seattle about the time of the National Electric Light Association's convention there.

MINE PRODUCTION IN 1910 AS REPORTED BY THE U. S. GEOLOGICAL SURVEY.

The mine output of gold, silver, copper and lead in California in 1910 had a value of $27,020,405, according to figures compiled by Charles G. Yale and just made public by the United States Geological Survey. The production of gold was $19,715,440; that of silver 1,840,085 fine ounces, valued at $993,643; that of copper 48,700,756 pounds, valued at $6,184,996; and that of lead 2,870,977 pounds, valued at $126,323.

These figures show a decrease in the output of gold, silver, and copper as compared with the figures for 1909, but a large increase in lead. The 1909 figures are as follows: Gold, $20,237,870; silver 2,098,253 ounces, valued at $1,091,092; copper 57,288,281 pounds, valued at $7,447,476; lead, 1,502,597 pounds, valued at $64,612.

PRESERVATION OF POLES.

An interesting fact disclosed by the figures from the recent census statistics is the rapid growth of the practice of treating poles in order to prolong their period of use. In 1910 824,673 poles, or more than 21 per cent of the total reported purchases for that year, were given some preservative treatment. This number was an increase of 248,042 poles, or 43 per cent over that of 1909; 480,285, or 139.5 per cent over that of 1908; and 428,474, or 108.1 per cent over that of 1907. In 1910 the class of pole users which applied preservatives most extensively was the electric railroad, light, and power companies, 29.4 per cent of the reported purchases having been given some treatment of this character, as against 19.9 per cent by steam railroads and 19.4 per cent by telephone and telegraph companies.

GENERATING PLANTS AT VICTORIA FALLS.

The Victoria Falls & Transvaal Power Company has at present three generating stations in South Africa, the old one at Brakpan and two new ones at Rosherville and Simmer Pan, while the foundations for the station at Vereeniging are now being proceeded with.

The Simmer Pan plant comprises six impulse turbines of 4500 brake horsepower each. The generation is three-phase, 50 cycles of 5000 volts transformed to 10,000, 20,000 and 40,000 volts, as required. The whole system is managed from the control room, which is in charge of an engineer in telephonic communication with every part of the system. The scale of prices is as follows (1 penny = 2 cents):

Load factor. Per cent.	Per unit from Oct. 1, 1910, to Sept. 30, 1912. Pence.	Per unit after Oct. 1, 1912. Pence.
10	2.512	2.475
15	1.754	1.717
20	1.375	1.338
30	.995	.958
40	.807	.770
50	.692	.655
60	.617	.580
70 and over	.5617	.525

The actual cost of generation has not transpired, but at the station of the Randfontein Central, where coal costs more in consequence of 25 miles extra haulage, the cost has been brought down to below a farthing (½ cent) per unit at the switchboard and 0.4d. (0.8 of 1 cent) into motors all over the property. When the central mill is in full operation and the amount generated increased, with consequent spreading of the standing charges, it is confidently expected that these figures will be improved upon.

The stations of the Victoria Falls Company are being worked at their fullest capacity, the Rand mines requiring considerably more power than they originally contracted to purchase. At some mines, consequent upon the scarcity of hammer boys, the old steam plants have lately been started up so as to supplement the supply of electricity and compressed air in bulk.

AMERICAN EXPORTS.

According to the American Manufacturers' Association's reports the increase in the exported manufactures of the United States in the last year was almost $150,000,000; while the total values of those products had reached $915,000,000 in the last fiscal year. The coming convention will be unique in many ways. It will bring together for the first time in the history of American commerce the leading exporters, manufacturers and export managers in the United States.

PACIFIC COAST GAS ASSOCIATION.

In the following columns will be found a continuation of the papers read before the recent convention, in Oakland, of the Pacific Coast Gas Association. Committee reports will be found appended before the editorial page of the Journal. The paper of Professor C. L. Cory, started in the last issue of the Journal, will be found concluded in this issue:

THE NAPHTHALENE PROBLEM IN OIL GAS MANUFACTURE AND DISTRIBUTION.

BY F. S. WADE.[1]

In the following paper I will not attempt to offer any new theories concerning naphthalene, its formation, its deposition, its removal; too many have already been offered. I will only endeavor to state the theories which most clearly follow invariable physical laws and the facts as I have observed them.

Let us first consider the nature and origin of naphthalene. As we only too well know, it is a white crystalline, solid hydrocarbon, 93.7 per cent carbon and 6.3 hydrogen; it has a melting point of 176° F. and boils at 424° F. At the ordinary temperature, its vapor tension is very low, but, as will be seen by the attached curve, one that rises very rapidly with increases in temperature above about 90° F. It has the rather peculiar property of passing from a vapor to a solid with no intermediate liquid condition, and this property, more than any other, causes its intensely objectionable features as a hydrocarbon in illuminating gas.

Naphthalene is quite generally formed when organic substances are decomposed at a red heat. For example, it is readily made in the laboratory by passing alcohol, ether, benzine and acetic acid through red hot tubes. I have made, when experimenting with the decomposition of California petroleum in a small iron retort, at a temperature below 1600° F., naphthalene in sufficient quantities to quickly stop up a ⅜ in. off-take pipe. It may, therefore, be safely stated that any process of making gas, of say 20 candle-power, or 640 B.t.u. from petroleum, will make more than enough naphthalene to saturate gas as it leaves the wash-box at a temperture of, say 150° F. This statement is readily proved by the fact that a small quantity of solid naphthalene is invariably found in the carbon from the wash-box, showing that an excess of naphthalene crystallized out when the hot gas coming from the generator was cooled on striking the water in the wash-box. There can be no doubt that very high temperatures in the generator make excessive quantities of naphthalene, but this extra amount will appear only as a greater percentage in the carbon and tar; places where it does no particular harm. It is my opinion that any effort looking to the elimination of naphthalene trouble by doing away with its formation in the generator is misdirected.

If we admit that considerable quantities of naphthalene will be made by the oil gas process under the most favorable circumstances of manufacture, the question then becomes how best to prevent its depositing in troublesome quantities and places.

The vapor tension of naphthalene is such that the following quantities are carried by gas when saturated:

Temp. Deg. F.	Grains per 100 cu. ft.
50	7
60	13
70	24
80	42
90	71
100	117
110	182
120	276
130	403
140	628

[1] Chemist, Los Angeles Gas & Electric Corporation.

At these various temperatures, 100 cubic feet of gas can carry the number of grains stated and no more. It is, therefore, evident that if gas leaves a works saturated with naphthalene at 80° F. and encounters somewhere in the distributing system a temperature of 60° F., 29 grains of naphthalene will be deposited for each 100 cubic feet of gas. And worst of all, wherever a drop in temperature is encountered, naphthalene is deposited in a small space in the form of thin crystalline plates growing out from the interior surface of the pipes at right angles to the flow of gas. This habit of crystallization enables a minimum weight of the solid to offer a maximum of obstruction to the flow of gas.

A great deal has been said and written about the effect of water vapor, benzol, ammonia and other vapors upon the deposition of naphthalene. Experiments to study these points were made by holders of the Gas Engineering Fellowship of the Michigan

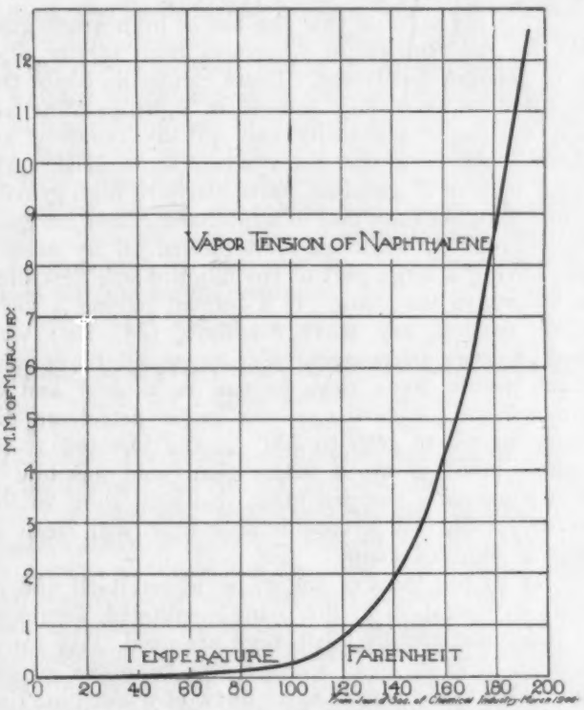

Chart Showing Vapor Tension of Naphthalene.

Gas Association at the University of Michigan under scientific conditions which would be difficult to duplicate in the industrial gas laboratory. The results of these experiments were published in the proceedings of the Michigan Association for 1905, and may be consulted at length therein. It was found that, with the single exception of gas containing benzol vapor, the nature of the mixed vapors or gases, of which naphthalene vapor formed a part, had no effect upon the vapor tension of naphthalene. In other words, crystals of naphthalene would be deposited in the same quantities at the same temperature from air, hydrogen, acetylene, dry coal gas, coal gas saturated with moisture, or heavily charged with ammonia. It appeared that gas containing a considerable amount of benzol vapor was able to carry a greater quantity of naphthalene without deposition. Benzol is not, however, found in sufficient quantities in oil gas to have any serious effect.

In view of these facts, it may be safely stated that the only important factor in naphthalene deposition is temperature change. It may also be stated, that so long as gas reaches before leaving the works, a temperature as low as the lowest it will encounter in the distributing system, there is no possibility of naphthalene being deposited. Unless a plentiful supply of cold water can be had, this condition of temperature is hard to obtain in the works, so the problem becomes how to reduce the naphthalene content to a safe point, when unable to reduce the temperature.

One method of successfully obtaining this result can probably be best described by briefly stating the experiences through which the Los Angeles Gas & Electric Corporation passed.

The water supply of this company was entirely inadequate to reduce the gas to a temperature which would keep large amounts of naphthalene from leaving the works. The average temperature of gas leaving the purifiers was always 80° F., and at times of water shortage was well over 100° F. At all temperatures, according to picric acid tests, the gas was saturated with naphthalene. Cool city water was used in the station meters, so that the gas suffered quite a drop in temperature upon entering them, with the result that the meters became completely blocked with naphthalene in about two weeks. They then had to be shut down and steamed for tweny-four hours, during which time about one hundred pounds of solid naphthalene would melt and run out. Sixteen inch mains leading from the works to the storage holders had to be steamed out at similar intervals. Complaints of stoppages, from consumers, were exceedingly numerous, and at the time of installing the first oil scrubber, July, 1906, had reached over 500 a day.

Every effort was made to reduce the temperature of the gas at the works, and at one time the installation of a refrigerating system was even considered. A small scrubber using 45° Be′ distillate as a solvent had been installed two years before and was successful in handling a small volume of gas, but it was expensive in operation. Experiments were made with tar from the works as a solvent, but it was found to be in all cases too highly saturated with naphthalene to be of further use. In some cases the tar actually gave off naphthalene to the gas it was washing. Fuel oil of 16° Be′ was tried in an experimental scrubber with results so gratifying that a water tank, twenty feet in diameter by sixty feet high was hurriedly converted into a scrubber, and the fuel oil supply of the plant used to wash the entire gas output. The amount of naphthalene was reduced to about 15 grains per 100 cubic feet in the gas leaving the scrubber, but on account of the great number of stoppages then occurring it was desired to send out gas altogether free from naphthalene. The entire supply of gas oil (19.5° Be′) was, therefore, turned through the scrubber, with the result that so long as the gas entered at a temperature not much above 90° F., it went out so clean that a picric acid test run for nine hours showed no precipitate. Whenever gas at the inlet reached a temperature of 95° F., amounts of naphthalene, increasing

with the temperature, passed through the scrubber. This is explained by the rapidly increasing amount of naphthalene carried into the scrubber as the gas grew hotter. The same oil has been used for removing naphthalene, and subsequently in the generators for making gas, at this plant for five years, and so far absolutely no bad effect has been noticed on account of this practice.

The very fact that crude oil would dissolve and remove the vapor of naphthalene from gas, led me to suspect that it would also remove serious amounts of other more abundant and valuable hydrocarbons. Therefore, I made, early in the experimental stage of oil scrubbing, a careful investigation of its effect upon the quality of gas. Tests with Junkers' Calorimeter and a bar photometer failed to show any appreciable loss in calorific or lighting value and gas analysis did not show any change in the percentage of hydrocarbons absorbed by bromine. It is possible that there is an exchange of hydrocarbons between the gas and the crude oil, but whatever the action, there is no detectable change in the commercial quality of the gas treated. Gas saturated at 70° F. contains .01 per cent by volume of naphthalene vapor, or a cubic foot contains .24 grains having a heating value of 0.6 B.t.u. Assuredly the removal of these amounts of naphthalene alone cannot seriously affect the quality of the gas.

The effect of oil scrubbing upon the organic sulphur content of gas was also investigated, and no appreciable results were recorded with the oil being used. It certainly would not do to wash gas with oil containing free sulphuretted hydrogen as found in the oil produced by some wells in the Sherman and Coalinga fields.

Immediately after the installation of oil scrubbing the reduction in naphthalene complaints was slight, if any, and the practical success of the system was severely questioned, even though chemical tests showed it to be doing all that could be desired. No trouble whatever was given by the station meters or large mains from the day that the first oil scrubber was put in use. A considerable decrease in the number of complaints was noticed in about a month, and from then on the number gradually lessened and the complaints came from farther and farther from the works. As late as two years after commencing oil scrubbing, during certain short periods of hot days and cold nights, as many as 100 stoppages were reported in a single day. During the past year complaints of naphthalene have entirely disappeared; not a single case having been reported in several months.

The long time required for the disappearance of trouble is accounted for by the fact that the entire distributing system, including the storage holders, were heavily charged with naphthalene which the clean, warm gas leaving the works readily absorbed, only to deposit farther out when a lower temperature was encountered. Numerous tests were made from time to time showing the cleaning of the system in progress. At an early period clean gas from the works was practically saturated when leaving the storage holders ⅜ of a mile away. Later on the gas did not contain serious amount of naphthalene. It was two or three miles out. The greatest persistence of trouble occurred in the outlying districts where pipes had been longest laid.

The trouble given by gas delivered directly from the high pressure system was always much less than on the low pressure. Some trouble, however, was caused by minute quantities of naphthalene, often a single crystal, clogging the small openings in regulators. Gas which is saturated with naphthalene, compressed to thirty pounds a square inch and subsequently cooled, while still under pressure, to its original temperature, must, on account of the well laws of vapor tension, drop two-thirds of its napthalene. Therefore, naphthalene will be deposited in large quantities when hot gas from a compressor passes into pipes in the cool ground. In our system we found much naphthalene dissolved in an oily condensation deposited in drips within two miles of the compressor station. In this liquid condition it was entirely harmless and easily removed.

It is my opinion that the use of high grade gasoline for the removal of stoppages from service pipes is, in general, ill advised. There can be no doubt that naphthalene is readily soluble in light gasoline and that stoppages are easily and quickly removed and blown back into the main when it is used. The vapor tension of gasoline, particularly of high gravity, is much higher than that of naphthalene, and the gasoline solvent is, therefore soon carried off by passing gas, having a large part of the naphthalene deposited, as before, in the main. If a solvent having a lower vapor tension, say stove distillate, (34° Be') were used, a more permanent solution would be formed, which would have time to run to a drip and be pumped out. Likewise, a low grade petroleum distillate heated to 180° to 200° F. and injected at the highest point is much better than cold gasoline to clear a partially stopped main. Nothing short of live steam applied for a considerable time will clean an entirely stopped main.

As to the form of the oil scrubber itself and its mode of operation in the plant mentioned, scrubbers 20 ft. in diameter by 60 ft. high are used. Gas enters through a 30 in. pipe about 7 feet from the ground and leaves at the top. Layers of two-by-four pine timbers, lying on edge, leaving a two inch gas space, are placed throughout the height of the scrubber. The timbers in successive layers are arranged to form a spiral, so as to thoroughly mix the ascending gas with the descending oil. A 10 x 6 x 12 in. double acting pump is used to raise oil in a three-inch pipe and discharge it through six openings, ⅜ in. in diameter. About four feet of oil is maintained in the bottom of the scrubber, which is used for circulating in connection with enough fresh oil to keep the mixture far below saturation with naphthalene. Of course, as fast as fresh oil is drawn in, old oil goes out into the works lines and is used. A scrubber such as I have described, using about four gallons of fresh oil per minute and enough used oil to keep a pump of the above size, running at a normal speed, is capable of reducing the naphthalene of 10,000,000 cubic feet in twenty-four hours, from 70 grains to 5 grains per 100 cubic feet.

A few words as to the method which I have found most satisfactory for determining the amount of naphthalene in gas, may be of interest. A solution of picric acid is prepared by dissolving with gentle heat 12 grams of the acid in one liter of water. If not clear, the solution should be filtered and then standardized by titrating 20 cubic centimeters with tenth normal caustic potash, using lacmoid indicator. Two hundred cubic centimeters of the solution is placed in an all glass gas washing bottle, and the gas to be tested bubbled through it, and thence into a meter, at a rate not exceeding two cubic feet an hour. After not less than ten, or more than forty cubic feet of gas have passed, the bottle is disconnected and the solution filtered. I have found in our Southern California climate, any special precautions such as warming before filtering quite unnecessary. Twenty cubic centimeters of the filtrate is titrated, as when standardizing the original solution and the number of cubic centimeters of caustic potash required to neutralize the used acid is deducted from the number required by the original solution. The result is multiplied by 197.1 ($= 10 = 1 \times 100 \times 15.4 \times .0128$) and divided by the number of cubic feet of gas tested, which gives the number of grains of naphthalene per 100 cubic feet. It is very important that the gas pass directly into the washing bottle without the intervention of any rubber tubing, as rubber absorbs naphthalene readily. The use of a train of several wash bottles, as recommended by most text books, is unnecessarily tedious for commercial testing.

UNSTABLE HYDROCARBONS IN ILLUMINATING GAS.

BY. E. C. JONES.

Defining the quality of illuminating gas in terms of candle-power served its purpose after a fashion while gas was used almost exclusively for illumination, and when over 90 per cent of all the gas sold, was consumed through open flame tips for lighting, there seemed to be no other way to arrive at a tangible value excepting to measure the light emitted by the burner commonly used to burn the gas. And this value was expressed in terms of candles, with full knowledge that the light of a candle is as inconstant as the moon.

Every generation of thinkers in the gas industry has sought a reliable and unchangeable unit for the measurement of light, but the standard candle with its uniform weight and composition and under normal conditions burning at the rate of 120 grains of its substance each hour, has survived the results of all these efforts.

It is not the purpose of this paper to discuss the wide field of photometry, but to touch on a few points in order to emphasize the importance of some of the experiments with illuminants on which candle-power depends, and to plead for a heat unit standard of value. While the candle is nominally the unit of light measurement, yet to reduce errors the Pontane lamp and other multi-candle power lights are substituted, while in France the Carcel lamp is used, and in Germany the Hefner unit takes the place of the candle. But whatever light is used as a standard the results of the findings are invariably expressed in multiples of the good old unreliable candle.

Enough for the "constant" end of the bar photometer, and now to consider the variable end, or the gas light to be measured. When the gas was very poor, in the early days of gas, the burners were also poor and through successive stages of inventive development the quality of gas was improved, and the burner through which it was transformed into light, was also improved.

The German lava tip Argand burner developed more candle-power than the crude iron "fishtail" and "batswing" burners, but the work of Sugg, produced the Standard Argand burners now in universal use in photometry. These burners are made in a series adapted to the requirements of different kinds of gas, and by ingenious contrivances the proper amount of air is supplied for combustion to gas issuing from openings of the right size in the burner. The different burners also require glass chimneys of different diameters and heights to assist combustion.

The Sugg Argand burner has been accepted as a satisfactory standard for photometric comparison, it having been generally conceded that this burner develops more light measurable as candle-power than any other. The only exception to this, was the application of the Sugg burner to carburetted water gas, when it was found that an open flame tip, of the Bray type, developed more candle-power. Many of the municipal ordinances concerning candle-power provide that the gas shall be tested by a burner best adapted to general use for house illumination, this requirement would be filled by the open flame burner better than by the expensive and complicated Sugg Argand burner, with its glass chimney.

Other factors which affect the art of photometry in its exactness as a science, are the color of the lights compared, and the question of intensity of light, and its diffusion, resulting in the arbitrary adoption by different observers of photometer bars of either sixty or one hundred inches in length. The area of the light emitting flame has much to do with illumination and it is a question if this is fully appreciated by the reflections of the little grease spot, on the Bunsen disc.

The wonderful and revolutionary discoveries by Dr. Carl Auer von Welsbach have changed our aspects of the intrinsic and economic value of gas. Previous to these discoveries the use of gas for cooking, heating, and other industrial purposes had steadily increased, utilizing the best giving qualities of gas, and to a certain extent, ignoring, the highly sensitive portions that constitute its chief value as an illuminant, in fact, the most valuable light giving hydrocarbons often interfere with complete combustion, in appliances designed solely to develop heat from gas.

The advance in the use of gas for heating was accompanied by a wane in the use of gas for lighting; this was caused by many well known reasons, amongst which was the lively competition of electric lighting, which had it not been checked by the incandescent gas light, with its high efficiency and economy, would have obliterated gas from the field of artificial illumination. As it is, however, probably as

much as eighty per cent of all gas sold is used for its heat, while a large portion of the remaining twenty per cent is used for illumination by the application of the heat of the gas to incandescent mantles, and a very small amount of gas is used for illumination directly through open flame burners. This amount is at present, or is rapidly becoming, negligible, for it is difficult to imagine a use for an open flame burner which would not be better served by an incandescent burner, with better light, and less cost. And it is for the regulation of this insignificant, and almost obsolete use of gas, that the candle-power standard is maintained.

A little missionary work on the part of gas companies would quickly replace the open flame burner with incandescent burners by the use of the never failing explanation, that the consumer gets three times as much light for half as much money.

Once removed from the field, these open flame burners would eliminate the only reason for retaining a candle-power standard.

The Welsbach burner utilizes the heat of the gas to raise the temperature of refractory earths to a condition of incandescence, with the result that five cubic feet of twenty candle-power gas converted to heat, and applied to a mantle, yields light to the amount of over one hundred candle-power, and when used under high pressure will develop as much as 70 candles per foot of gas.

To accomplish this end, the air necessary for complete combustion is mixed with the gas in a Bunsen burner, which reduces the illuminating flame to a non-luminous heating flame, thus destroying all the results obtained by the refinements of gas making which produce uniform high candle-power, including careful condensing and scrubbing, and expensive and sometimes difficult enriching. This same Welsbach burner would technically meet the requirements of a standard burner for photometrical use, as it is undoubtedly the burner best adapted to household illumination, but for obvious reasons it has never been so used.

A quest for a remedy for naphthalene deposits led the writer to experiment with the use of crude petroleum and distillates for scrubbing gas for the removal of naphthalene. This work was begun with some latent prejudice born of early experience in coal gas making, when it was an axiom of the craft that the finished gas must not be brought in contact with oil, because of the disastrous effects upon the candle-power of the gas. This knowledge of the havoc wrought by oil upon the unstable illuminants of coal gas precluded the use of oil in gas holder tanks, and seals, for the purpose of preventing freezing of the water. This was sane reasoning, because the substitution of crude petroleum for water in a scrubber of the "Standard" type would reduce an eighteen candle coal gas to a practically non-luminous gas, and candle-power of coal gas is too expensive and difficult to attain to warrant the sacrificing of any part of it.

The first series of experiments to determine the action of petroleum upon candle-power was conducted by passing the gas slowly through a dip scrubber, the gas passing through a sleeve perforated with holes 3/32 of an inch in diameter, and breaking a seal 1½ inches deep of oil. The gas made one passage through this oil seal and then passed directly to the bar photometer for test.

A large sample of gas stored in a test holder was used for this purpose and the candle-power of each sample was taken.

California crude petroleum of 16.5° Beaume was used for the tests, and the oil for scrubbing was heated to different temperatures to try and find out if heating the oil would cause it to remove naphthalene without destroying the candle-power of the gas.

Following is a series of tests made with oil gas and mixtures of oil gas and lamp black water gas:

No. of Tests.	Temp. of oil used.	Candle-power before scrubbing.	Candle-power after scrubbing.	Loss in candle-power.
1	87° Fah.	21.3	17.4	3.9 candles
2	100 "	21.1	16.9	4.2 "
3	163 "	20.5	16.9	3.6 "
4	130 "	19.4	16.9	2.5 "
5	130 "	19.6	17.1	2.5 "
6	130 "	17.4	13.5	3.9 "
7	130 "	17.4	13.4	4.0 "
8.	130 "	17.0	12.6	4.4 "
9	130 "	17.0	12.7	4.3 "
10	130 "	19.0	13.2	5.8 "
11	120 "	19.0	13.3	5.7 "
12	110 "	19.0	13.3	5.7 "
13	100 "	19.0	13.7	5.3 "

The summary of these thirteen tests of gas passing once through oil was:

Highest candle-power of gas before scrubbing	21.3 candles
Lowest " " " " "	17.0 "
Highest " " " after "	17.4 "
Lowest " " " " "	12.6 "
Greatest loss of candle-power	5.8 "
Average loss of candle-power	4.29 "

From these results it would seem that even slight contact of illuminating gas with oil causes a loss in candle-power, and that the amount of loss is not directly proportional to the temperature of the oil used, provided the temperature of the oil is below the flash point.

After these experiments it occurred to the writer that partial scrubbing of gas with oil might be resorted to for the purpose of removing naphthalene, but it seemed certain that thorough scrubbing, with long, intimate contact between the oil and gas would destroy the candle-power.

A small experimental scrubber was made and was filled with wooden trays nicely fitted, so that neither gas, nor oil could by-pass the trays. This scrubber was constructed for the purpose of slowly scrubbing small quantities of gas in contact with an excessive amount of oil at temperatures ranging from 70° to 160° F. After having been convinced that oil is capable of removing certain hydrocarbons from gas, it was decided to adopt oil as one of the reagents for absorbing these illuminants during the experiments, and a Hempel Pipette was filled with crude petroleum of 16.5° Beaume and used in analyzing the gas immediately following the absorption of carbonic acid gas, and preceding the fuming sulphuric acid pipette, for illuminants. The hydrocarbons thus absorbed by oil are indicated in the following analyses as "Illuminants No. 1," while "Illuminants No. 2" are those absorbed by fuming sulphuric acid, after the oil pipette has been used.

EXPERIMENT A.

Oil Gas 17.9 candle-power (large sample in holder).
Carbonic Acid Gas = 2.5%
Illuminants No. 1. = 1.5%
Illuminants No. 2. = 4.8% } 6.3% total illuminants.

The gas at 17.9 candle-power was passed through the oil scrubber, and again tested for candle-power, and for illuminants No. 1 (with oil) and illuminants No. 2 with fuming sulphuric acid.

Temp. Oil F.	Candle-power.	Illuminants No. 1.	Illuminants No. 2	Total Illuminants.
70° Fah.	4.1	0.0	4.5%	4.5%
80° "	3.1	0.0	4.0%	4.0%
90° "	3.8	0.0	4.4%	4.4%
100° "	2.4	0.0	4.9%	4.9%
110° "	4.3	0.0	4.5%	4.5%
120° "	2.6	0.0	3.8%	3.8%
130° "	3.5	0.0	4.7%	4.7%
140° "	4.0	0.0	4.2%	4.2%
150° "	6.3	0.0	4.7%	4.7%
160° "	5.1	0.0	4.9%	4.9%

The maximum effect on the gas was with oil at 100 degrees F. when one passage through the scrubber reduced the candle-power from 17.9 candles to 2.4 candles and the hydrocarbons were reduced from 6.3 per cent to 4.9 per cent, in other words reducing the hydrocarbons 1.4 per cent by oil scrubbing, reduced the candle-power 15.5 candles.

EXPERIMENT B.

Oil Gas and Lamp Black Water Gas 19.8 candle-power.
Carbonic Acid Gas = 3.0%
Illuminants No. 2. = 6.9% } 8.4% total illuminants.
Illuminants No. 1. = 1.5% }

This test was in every way similar to Experiment A, excepting the gas used had higher initial candle-power and illuminants. The gas was scrubbed with crude oil 16.5° Beaume.

Temp. Oil F.	Candle-power.	Illuminants No. 1.	Illuminants No. 2	Total Illuminants.
70° Fah.	2.9	0.0	6.0%	6.0%
80° "	2.6	0.0	6.0%	6.0%
90° "	2.9	0.0	6.2%	6.2%
100° "	2.3	0.0	6.2%	6.2%
110° "	2.5	0.0	6.4%	6.4%
120° "	2.8	0.0	6.4%	6.4%
130° "	3.2	0.0	6.6%	6.6%
140° "	3.8	0.0	6.4%	6.4%
150° "	4.1	0.0	6.0%	6.0%
160° "	4.0	0.0	6.4%	6.4%

In this experiment the maximum effect was also with oil of 100° F. when the oil scrubbing reduced the illuminant from 8.4 per cent to 6.2 per cent and the candle-power from 19.8 candles to 2.3 candles, thus showing that 17.5 candles of illuminating value was produced by 2.2 per cent of the volume of the gas or by 26 per cent of the illuminants contained in the original sample.

EXPERIMENT C.

Oil Gas = 19.9 candle-power.
Carbonic Acid Gas = 2.2%
Illuminants No. 1. = 2.8% } 7.0% total illuminants.
Illuminants No. 2 = 4.2% }

In this experiment the gas was scrubbed with a distillate of 24° Beaume.

Temp. Oil F.	Candle-power.	Illuminants No. 1	Illuminants No. 2	Total Illuminants
70° Fah.	3.6	0.0%	5.2%	5.2%
80° "	2.9	1.3%	3.7%	5.0%
90° "	2.3	1.0%	3.8%	4.8%
100° "	2.1	0.0%	5.0%	5.0%
110° "	2.1	0.4%	4.2%	4.6%
120° "	3.4	1.2%	4.3%	5.5%
130° "	3.4	1.2%	4.3%	5.5%

The greatest reduction in candle-power in this experiment was with oil at 100° and 110° F. when the candle-power was reduced from 19.9 to 2.1 candles, and at 100° F. the illuminants were reduced from 7.0 per cent to 5.0 per cent, or a loss of 12.8 candles by a reduction of 2 per cent of illuminants. These experiments all demonstrate the instability of a portion of the hydrocarbons, and the large proportion of the total candle-power produced by a small amount of illuminants.

The illuminants that are removable by oil contain the cause of all naphthalene deposits, and the bulk of condensation other than water in street main drips. They are the seat of candle-power fluctuations and are affected by changes in gas humidity, or water vapor content in the gas. They are also easily removable by compression. A glance at the tables of candle-power would impress an observer that the scrubbing by oil had rendered the gas useless and unsalable, yet the calorific value of the gas remains practically undisturbed. The loss in candle-power is not accompanied by any proportional or even significant loss in B.t.u. During the progress of the experiments, it was noticed that after repeated use of the same oil for scrubbing, the oil becomes spent, or saturated by repeated exposure to hydrocarbons and it was necessary to use fresh oil for each test. To determine the capacity of a given oil to absorb hydrocarbons the following experiment was made:

A small oil scrubber was constructed and a special sensitive balance was used for weighing the apparatus and its contained oil, and the increment due to the absorbed hydrocarbons.

The apparatus weighed.. 1740.2 grammes
The oil used weighed... 118.0 grammes = 4.165 oz.

Total weight of apparatus and oil ..... 1858.2 grammes

The oil used was California crude petroleum of 14.8° Beaume at 60° F., .9682 specific gravity and weighing 8.055 pounds per gallon. Oil gas of 20.3 candle-power was passed through the scrubber at a rate of five cubic feet an hour for two hours and then at the rate of ten cubic feet an hour for a period of 1 hour and 30 minutes.

The candle-power was taken by Bunsen Bar tests, and the lessened decrease in candle-power shows the progress of the saturation of the oil by hydrocarbons and finally its failure to absorb any more of the illuminants.

OIL GAS USED 20.3 CANDLE POWER.

Time	Cu. ft. of gas passed through scrubber	Candle-power after scrubbing.	Lessened decrease in Candle-power
12:00 M.	Start	7.2 candles	
1:00 P. M.	5 cu. ft	16.5 "	9.3 candles
2:00 "	10 "	18.7 "	2.2 "
2:30 "	15 "	20.0 "	1.3 "
3.00 "	20 "	20.6 "	0.6 "
3:30 "	25 "	20.7 "	0.1 "

After scrubbing, the apparatus and oil weighed 1861.00 grammes, a gain of 2.8 grammes, equal to 2:37 per cent in weight of hydrocarbons absorbed from 25 cu. ft. of gas.

The oil after having been used for scrubbing was 16.5° Beaume, an increase of 1.7° Beaume.

The following analyses of two samples of gas taken simultaneously, show that oil removes nothing but hydrocarbons of the illuminant content of the gas.

Carbonic Acid Gas	3.0		3.0	
Illuminants	7.7	No. 1.	1.6	7.7*
		No. 2.	6.1	
Oxygen	0.2		0.2	
Carbonic Oxide	10.1		10.1	
Hydrogen	41.7		41.7	
Marsh Gas	31.6		31.6	
Nitrogen	5.7		5.7	
	100.0		100.0	

*Note:—Illuminants No. 1 were removed by absorption in oil. Illuminants No. 2 were removed by absorption in fuming sulphuric acid.
Candle-power. 19.0.
British thermal units, 671.
Specific gravity, .408.

It is possible that a uniform system of gas making, using oil of even quality, through ranges of temperatures comparatively constant, may produce gas of which the candle-power and heat units appear to bear a fixed relationship to each other. This relationship is misleading, however, as heat units and candle-power are not entirely dependent, one upon the other, any more than is the percentage of illuminants contained in the gas a safe measure of candle-power.

This is well illustrated by the following experiments. Oil gas of 19.6 candle-power and containing 7.7 per cent of heavy hydrocarbons was analyzed to determine its constituents. The benzine was removed with nickel ammonium cyanide, and the other heavy hydrocarbons with fuming sulphuric acid, another sample of the same gas was analyzed, using the oil pipette, and then the fuming sulphuric acid. And finally another sample of the same gas was passed through the oil scrubber and then analyzed.

	Original gas.	Gas after oil scrubbing.
Candle-power	19.6 candles	4.9 candles
B.t.u. (by Junkers' Calorimeter)	657	627
B.t.u. (by analysis)	715	689
Specific gravity	.493	.489

ANALYSIS.

	Original gas	Original gas using oil pipette	Gas after scrubbing with oil
CO_2	2.6%	2.6%	2.6%
C_6H_6	1.0	0.0	0.0
C_nH_{2n} (oil pipette)		1.7	0.0
C_nH_{2n} (fuming sulphuric acid)	6.7	6.1	6.0
O_2	0.3	0.2	0.4
CO	10.0	10.2	10.3
H_2	37.5		37.7
CH_4	37.1		37.7
N_2	4.8		5.3
	100.0		100.0

The reduction in candle-power due to passing the gas through the oil scrubber was 14.7 candles, or 75 per cent. The reduction in heating value by Calorimeter, was 30 B.t.u. or 4.6 per cent and by analysis was 26 B.t.u. or 3.6 per cent. The experiment shows that 75 per cent of the candle-power of the gas was produced by 1.7 per cent of illuminants, and that this great reduction in candle-power only affected the heating value 4.6 per cent.

Some experiments in the making of coal gas, in 1901, were made from bituminous coal, by passing the gas through a second chamber containing highly heated coke, with the result that the hydrocarbons in the gas were entirely broken down and the finished gas was non-luminous, yet it had the characteristics of coal gas, excepting hydrocarbons, and contained about 700 B.t.u. per cubic foot. Some of the unstable hydrocarbons in illuminating gas are theoretically very high in heat units as for instance:

Naphthalene	$C_{10}CH_8$	6176 B.t.u. per cu. ft.	
Benzine	C_6H_6	4010	" " "
Propylene	C_3H_6	2509	" " "
Ethane	C_2H_6	1853	" " "
Ethylene	C_2H_4	1673	" " "
Acetylene	C_2H_2	1555*	" " "

The perfect and complete combustion of these illuminants should develop the theoretical high candle-power, and heating effect, but it is impossible under ordinary conditions to provide a perfect admixture of air to a burner, and the result is a smoky flame, or loss of heat.

*Stillman's Engineering Chemistry.

The Bunsen burner attachment for consuming gas in the calorimeters of the Junkers' type will not develop the theoretical heat units of any of these hydrocarbons, if burner undiluted. Acetylene, one of the illuminants of our city gas, and now commonly used as an illuminant for automobiles, has a calculated heating value of 1555 B.t.u. per cubic foot, and yet this gas cannot be burned with an air mixture in a Junkers' calorimeter, and an imperfect test of this gas would not develop more than half of its calculated heat units. This being true of the richer hydrocarbons burned separately, may it not be true also of different mixtures of these hydrocarbons with diluents, burned through a Bunsen burner of a calorimeter, intended for testing gases of more uniform composition, and apparently readily burned in that type of burner. The fact that the results of calculating heat units from analyses are invariably higher than those obtained by calorimeters of the Junkers' type seems to prove this assertion.

The adoption of a heat unit standard will not permit the gas manufacturer to make an inferior gas, nor to vitiate the gas with inert, or impure gases. It will simply enable him to make a more stable gas which will withstand the shocks of changes of temperature, and humidity, and the effect of friction in pipes and fittings. To fulfill the requirements of a standard of 500 B.t.u. per cubic foot, the gas would have to contain a large percentage of marsh gas, or other stable hydrocarbons. Hydrogen alone would not meet this requirement, for although it is an exceedingly hot gas when considered by weight, it is also a very light gas and contains but 344 B.t.u. per cubic foot. Carbonic oxide has a value of 343 B.t.u. per cubic foot, and either alone, or mixed with hydrogen would not meet the above requirements.

Where water gas is now used as an enricher of coal gas, in the event of the adoption of a heat unit standard, the water gas may be used as a diluent heating gas, consisting mainly of hydrogen, marsh gas, carbonic oxide, and a small amount of stable illuminants. This gas would help to dilute, sustain and consume the illuminants of coal gas.

Some of the California natural gas of the Midway field, now being supplied to Bakersfield, contains as much as 99.1 per cent of marsh gas and has a heating value of 1063 B.t.u. per cubic foot. This is a good heating gas, and may be used for illumination in incandescent burners, yet the gas has little, if any, candle-power.

Calorimetry is more nearly an exact science than photometry, because the total heat of combustion of gas may be measured by accurate thermometers, or the theoretical heat units may be quickly calculated from analysis. There are also many ways of burning the gas with oxygen, (notably Hempel's) whereby the heating value of the gas may be determined without any practical error.

In changing from the candle-power to the heat unit standard, all of the errors which enter into photometry are eliminated, and not the least of these is the personal error of the observer, sometimes amounting to as much as ten per cent. For after all of the refinements of photometric testing have been prac-

ticed, the final determination of the candle-power must rest upon the visual impression of light upon the human retina, and there are no instruments for measuring the fallibility of human judgment.

Gas of 500 B.t.u. to the cubic foot, would be a satisfactory gas for the use of the consumer, it may be non-luminous, but would probably be a gas of low candle-power, and it would not in any sense be a poor gas, nor could it be carelessly made. Such gas would stimulate new uses for gas, and these new uses would increase the production, thus resulting in economies in manufacture, redounding to the benefit of the manufacture, as well as the consumer.

RATES FOR GAS SERVICE.[1]

BY C. L. CORY.

Working Capital.

A gas plant and system in operation must have working capital as well as fixed capital. Stores and supplies which are included in the fixed capital do not represent all of the working capital such plants require. There must be available a reasonable cash balance and other current allowances in order to operate economically and effectively. Just what sum represents a fair amount for working capital is nearly always a matter of judgment. From the amount of working capital usually carried by such companies and from the amount that is required by other similar public utility corporations, it appears that as an average for the year a sum equalling the accounts receivable and cash on hand less the accounts payable and consumers advance payments is a reasonable allowance. The cash on hand, however, should be considered as that which is ordinarily required for the operation of the plant and the conduct of the business, including contingencies and emergencies, and should not include the capital or ready cash necessary for the construction of extensions or enlargement of the plant, or balances resulting from the sale of bonds or stock or in any case exceed the amount normally needed and used by the company as an operating property.

Such an inventory coupled with what might be called the inventory costs serves to obtain the detailed and segregated costs of the various elements going to make up the physical property of the plant. In addition in order to estimate the total valuation it is necessary to ascertain as nearly as may be the time required for construction in order that interest upon the investment during the construction period may be estimated. The cost of engineering, supervision, fire and casualty insurance, administration, legal expenses and other factors must also be obtained, preferably from the actual working conditions during which recent construction work was carried out.

Taken together the cost of reproduction new of the physical plant is usually considered to be the sum of the elements above enumerated. The cost of reproduction new has been variously interpreted, sometimes erroneously, especially when it has been held to mean a system identical with the one the valuation of which is under consideration. Properly, it should be understood as a plant of similar character and equal efficiency. The age of the system will have much to do in indicating the fairness with which the cost of reproduction new is considered.

It will depend upon conditions as to whether the cost of production new and the original cost very materially. One of the principal differences which will be found will be in the size and capacity and number of units in the two cases. Gas plants are probably never built in a single year, nor used exactly as they were originally constructed for a number of years. The original cost will probably properly cover the plants as installed with small units, while the cost of reproduction new may be considered to cover only the cost of a smaller number of much larger units having the same aggregate capacity. Especially would this difference arise in connection with the distribution system, both mains and services. Originally one single main on one side of the street of comparatively small size may have been adequate to provide gas service in that particular vicinity. Later on it became necessary to lay an additional gas main many times larger than the original and as is often the case this later main is laid upon the opposite side of the street, resulting in the cutting of all services leading to property on the side of the street where the new main is laid and the connection of those services into the new main, instead of the old. As viewed from present requirements, one gas main alone might be considered in obtaining the cost of reproduction new, while the actual cost would necessarily be greater.

Depreciation in Its Relation to Valuation.

While the original cost as well as the cost of reproduction new are ordinarily of the greatest importance in determining the proper valuation upon which earnings should be based, there is what is often called the present or existing value, or cost of reproduction new less depreciation, which must be given consideration in determining the valuation in question. Especially is this the case in plants the rates for gas service from which have been ample to cover operating expenses, including depreciation, and a fair amount for interest and profits, but the amount collected for depreciation has not been used as it should be and set aside for replacing portions of the plant discarded because of their becoming obsolete, inadequate or worn out, but on the contrary has been distributed to the stockholders in the shape of dividends.

Depreciation should be considered as the amount that must be regularly set aside to cover all portions of the plant that are discarded because of wear and tear, inadequacy, obsolescence and general unavoidable decay. It is an operating expense and should be borne by the customers through the rate paid by them for the service rendered by the utility. But as it is paid by the customers it must be set aside by the company and used when needed for the renewal of worn out and useless portions of the entire system, and under no circumstances should the cost of such renewals be made an additional charge to the capital or construction account except when the replaced equipment is of greater capacity than that which is taken out. Care must also be taken that the operating charge properly known as depreciation shall not be used for ordinary maintenance and repair. Actual

[1]Continued from issue of Sept. 23, 1911.

additions and extensions to plant which should be charged to the construction or capital account, replacement of equipment set aside as a result of depreciation, and ordinary repair and maintenance costs, must all three be most carefully separated and completely segregated in the engineering records as well as the financial accounts.

If construction, depreciation, repair and maintenance accounts are not so considered and depreciation is borne by the customers as a result of being included in the operating expense, and such depreciation fund is not used to keep the plant in its proper condition, but is paid in dividends to the stockholders, it is practically equivalent to the payment of dividends out of capital. Rates of service should be such as to include a reasonable charge for depreciation, and if the rates are such as to do this and the amount necessary to cover depreciation is not used as it should be, it cannot mean anything but that the money, either in surplus or dividends is going to the stockholders instead of being used for the purpose intended.

An allowance for depreciation obligates the company to use of this money in keeping the plant in thorough operating condition, and if it is not so used but is turned over to the stockholders, it simply means that a part of their capital is being returned to them, thereby reducing the investment in the plant. If this is the case, as a matter of fact the investment is so reduced and there should be corresponding reduction made in the actual investment presumably represented by the original or cost of reproduction new. In such instances, if the owners of the property, instead of keeping up the plant as they should by the proper use of the annual depreciation charge, have appropriated for their own use the money contributed by their customers, the annual depreciation should each year be deducted from the valuation of the plant which might otherwise be obtained.

Depreciation, like interest, continues constantly and is always present. Every part of the physical property of any system exclusive of the land begins to depreciate when the plant is completed and ready for operation; therefore, the depreciation charge should be constant. It of course may be that such depreciation covering a number of years may be arrived at as an average for a long period, and it will not be necessary to expend the average each year. This is of minor importance, however, providing the methods by which the depreciation charges are obtained are sound and reasonable.

Two methods are in common use for determining depreciation. The first is known as the straight line method, which involves determining the probable ultimate life of each element of the system, consideration also being given to the value of the discarded element as junk at the end of the period. In the straight line method it is assumed that during the entire life of each element of the plant the depreciation is uniform, which of course is not ordinarily the case as the rate of depreciation of a plant as a whole is much more rapid during the latter part of its life than during the first years of its use. Fairness to customers, however, in the different years, as well as safety to investors, indicates clearly the wisdom and correctness in considering the depreciation uniform throughout the entire life of each portion of the plant.

The second method of determining depreciation is upon the assumption that each year an amount is to be set aside and invested at compound interest so that this amount plus interest will be available to cover the cost of the replacement needed at the end of the period when the device or element is discarded, and replacement necessary. The so-called rates of depreciation will naturally be less in the latter method than in the former, since it is assumed that the depreciation fund will earn interest from the end of the first year or even shorter period. If we consider the life of some portions of a plant to be between twenty and thirty years, with the latter method it is necessary for us to in advance assume an interest rate which will continue during this entire period and this is an assumption which, judged by the last twenty-five year period, is hardly justifiable.

It may very properly be said that neither method exactly corresponds to actual experience. At the same time the rate of depreciation is something that must be carefully estimated for each individual plant and the data required compiled from the best information obtainable from those who have been in charge of construction and operation preferably for a number of years. If new devices are constantly being perfected and introduced rates of depreciation will be high due to the fact that older apparatus will become obsolete and inadequate at an early date. On the other hand, if the different portions of the plant are not subject to change as a result of improved or modified methods or distribution, rates of depreciation will be low, providing, of course, that wear and tear and ordinary deterioration are not severe with a reasonable expenditure for ordinary replacement and maintenance.

Intangible Elements of Value.

In determining the proper valuation, therefore, the original cost, cost of reproduction new, present value as affected by depreciation should all be taken into consideration. They are not the only elements, however, although they are usually the most readily determined. One element of value often suggested is that of "good will." The good will of a business is an asset that cannot be ignored in determining the valuation of a property, provided the element of good will is inherent in the business of a public service corporation which may have a practical monopoly. One of the most comprehensive and generally accepted definitions of good will is by Judge Story:

> "Good will may properly enough be described to be the advantage or benefit which is acquired by an establishment, beyond the mere value of the capital stock, funds, or property employed therein in consequence of the general public patronage and encouragement which it receives from constant or habitual customers on account of its local position or common celebrity or reputation for skill, affluence, punctuality, or from other accidental circumstances or necessities, or even from ancient partialities or prejudices."

Judge Hough must have had this definition of good will in mind in the case of Consolidated Gas Company vs. The City of New York, in which he says:

> "There is nothing in the nature of the business enabling it to acquire good will in the property sense or indeed in any other. It is required by law to furnish gas to all demanding

it within a certain distance of the mains; and it owns the mains, service pipes and meters. What induces a customer to remain with this company, its successor or vendee? Nothing that I can imagine, except a desire to avoid the nuisance of street digging in front of his house; a digging, however, entailing no expense upon him. Yet even this nuisance is in all human probability impossible of occurrence because of the beneficially monopolistic character of defendant's present occupancy of the streets of this city * * *. Finally, this claim of good will seems to forget that for many years the price of distribution of complainant's gas has been regulated by law. A citizen is entitled to have a clean street before his house because he pays taxes, inter alia, for that purpose. He is much more entitled to have complainant's gas in his house because the company must give it to him if he pays for it. I think it apparent that the conceivable good will of a gas company in this city is about equal to that of the street cleaning department of the municipal government."

The public service corporation operating where competition exists may have an element of good will in its valuation, but it is certainly of little if any, consequence where the public under any circumstances must obtain its service, if at all, from a single corporation.

In a somewhat similar manner may the assumed value of franchises be considered in determining the valuation of the property of a public service corporation. Based upon court decisions, the principal element in the value of a franchise is the earning capacity of the property of the corporation in connection with which a franchise is necessary. Viewed from this standpoint, since the earnings must be directly dependent upon the rates charged for service, it is evident that to include the value of a franchise as an element in determining rates developes an almost impossible situation. A franchise which is not exclusive can have no real value from any standpoint and is in reality little more than a permit to carry on the business and to do necessary work upon public property. As an element of value, even in the sale or transfer of the property, it is questionable whether such a franchise would be given serious consideration. If, however, a franchise is exclusive and is owned by a company, it may be considered of value and would be rightfully considered a part of the entire system if the business were sold. On this assumption it is proper to consider a franchise as a part of the taxable property of the company. On the other hand, while there may be some cases where the valuation of a property may rightfully include a certain sum as the value of the franchise, yet when this value must depend upon the rates for which service is rendered, it is difficult to see how it should be considered as a part of such valuation.

There is an element of value that must be taken into consideration in determining the valuation of a property and which is sometimes referred to as "Going Value." This is sometimes covered by an allowance usually in percentage to cover the difference between the cost of the physical property and the value of the completed system in operation providing service to its customers and possessing numerous valuable contracts for giving service in the future. Going value is of an intangible character and may be estimated in some instances by estimating the cost of developing the business which the company enjoys at any particular time. The data naturally is rarely obtainable to indicate the money actually spent by the company to obtain its business, since in recent years the period of time during which public service corporations have been ready for operation and yet not actually engaged in providing service, approximately at least up to their normal capacity, has usually not exceeded one or two years. When the earnings of a public service corporation have not been sufficient to meet reasonable expenditures for the development of its business and to cover operating expenses, depreciation and a reasonable return on the investment, the losses incurred in building up the business must be considered as one of the elements to be included in appraising a plant for the purpose of determining the proper rates for service.

Probably the most concise statement in this connection is from the decision of Justice Brewer in a most noteworthy decision in the case of the National Water Works Company vs. Kansas City in connection with the valuation of a waterworks which had been taken by the municipality:

"The original cost of the construction cannot control, for 'original cost' and 'present value' are not equivalent terms. Nor would the mere cost of reproducing the waterworks plant be a fair cost, because that does not take into account the value which flows from the established connections between the pipes and the buildings of the city. It is obvious that the mere cost of purchasing the land, constructing the buildings, putting in the machinery, and laying the pipes in the streets—in other words, the cost of reproduction—does not give the value of the property as it is to-day. A completed system of waterworks, such as the company has, without a single connection between the pipes in the streets and the buildings of the city, would be a property of much less value than that system connected, as it is, with so many buildings, and earning, in consequence thereof, the money which it does earn. The fact that it is a system in operation, not only with a capacity to supply the city, but actually supplying many buildings in the city—not only with a capacity to earn, but actually earning—makes it true that 'the fair and equitable value' is something in excess of the cost of reproduction."

In general it may be said that the courts have with few exceptions held that going value is an important and valuable consideration in determining a fair valuation for the property of a public service corporation devoted to public service. The difficulty, however is in obtaining a fair and proper figure in any given case. Competition may at any time seriously affect any estimate which may be made of the probable value of a going concern as contrasted with the physical plant without customers or contracts. It is probably most satisfactory to treat this matter primarily from the standpoint of the excess value of the completed system in operation over and above the original cost, cost of reproduction new, or cost of reproduction less depreciation, of the physical plant.

If this is done, however, such excess value of the completed operating system must be considered entirely separate from a percentage which may properly be considered as approximately the contractor's profit who undertakes to design, build and supervise the complete construction of an entire system, turning it over ready for operation to its owners.

The true value of a thing has been defined as the price upon which a purchaser and a seller mutually agree and at which figure an actual transaction takes place. If an existing plant and system were to be purchased and the owners were willing to sell at all, they would surely take into consideration what it would cost the purchaser to duplicate, not only the physical plant, but obtain all of the business enjoyed by them, and the prospective purchasers would surely consider what it would cost them independently to install a plant of equal general efficiency and usefulness, including the business developed and under control of the prospective sellers. In the long run,

the true value must be the capitalization of an assured income. A certain portion of this value is represented by tangible property and the remainder, if there be any, must be regarded as primarily traceable to the earning power of the business.

Gross Revenue, Cost of Operation and Quantity of Gas Manufactured and Sold.

Gas being a commodity, it is manufactured, distributed and sold to those who use it. As manufactured and sold it is divided into units which are usually 1000 cubic feet. The operating expenses may be properly divided into manufacturing, including fuel, distribution, general expenses, taxes and licenses and depreciation. For any period the unit cost may in a general way be obtained by dividing the total expense by the total quantity sold and the average cost per 1000 cubic feet is thereby obtained. Similarly, the unit cost for fuel and other station costs, for distribution, taxes and licenses, depreciation and general expenses, may also be determined. It is of importance also to know the relation between the total gas made and delivered to the holders and the quantity actually sold as per customers' meters. In this manner definite data is obtained for the leakage and the reduction in volume of the gas as measured by the station meters and by customers' meters.

The operating expenses can be definitely divided under two heads, fixed and variable. The fixed costs should include all expenses that are independent of the quantity of gas made but which remain practically constant whether the plant is operated at or near its full output, or at a fraction of this. Variable expenses include those costs that vary with the output and may be considered as of little consequence if gas is not made. Naturally, these two classes of costs are dependent and may vary widely.

It is not always possible to make a definite segregation of these fixed and variable expenses, but when necessary, approximate subdivisions may be made of expenditures involving both. The cost of manufacture per 1000 cubic feet depends largely upon the total amount of gas made, decreasing as the volume of production increases and increasing as the quantity made decreases, and a slight reduction in the sales will materially increase the cost of manufacture per 1000 cubic feet. The greater the sales the smaller is the cost of manufacture, but not in the same proportion for the total cost of service, when we include the distribution to customers' meters, and it is therefore of the greatest importance in discussing the rates for which gas may be sold to clearly distinguish between the cost of gas in the holder and when delivered to the customers' premises.

In general, it may be said that very large consumers involve a smaller cost per 1000 cubic feet than small consumers. The question naturally arises, should this difference in the cost of service to various classes of consumers be taken into consideration in determining the proper rates for service? The same rate for all is a term that is often much more beautiful in the abstract than when absolutely applied. Sometimes such a policy, when it means the same rate for all regardless of both cost and the effect upon the growth of the business, is a violation of sound business principles and decidedly against public policy. Often, uniform rates for a very large territory with the same class of customers may fulfill all requirements, but it does not follow that the best interests of all concerned are conserved where, in deciding upon a rate, it is made uniform for every customer. Very closely related to the fixed and variable expenses are capacity and output expenses, and in some respects they more clearly define the costs involved in the two classes of expenditures. There is a term known as "Consumer's charge" which may ordinarily be included as a part of the fixed costs of operation, and such expenses are directly proportional to the number of consumers taking service.

These considerations usually lead to the establishment of what is known as minimum rates or a minimum bill, which should be high enough to cover the cost to the company of the consumer independent of the quantity of gas which may be delivered to and used by him. Many times the actual consumption of gas for small customers is not a great factor in the cost of rendering service and from this standpoint the establishment of minimum rates would seem to be sound and thoroughly justifiable.

While no rates should be greater than the value of the service rendered, it is not necessarily equitable to charge the same rates to all regardless of the actual cost, and, as the cost of manufacture per 1000 cubic feet depends very largely upon the magnitude of the output, such a policy might not only tend to discourage large consumption but to actually increase the cost to small consumers. It may even happen that large quantities of gas should be sold at even less than enough to yield the regular rate of return rather than these quantities should not be sold at all.

This phase of the situation is often entirely neglected, not only by gas companies, but by those responsible for the adjustment of rates on an equitable basis. Failure to consider such opportunities often results in losses of great magnitude and thereby results in increased cost to all consumers. A wise and far-seeing management having all the information available can usually treat such matters most effectively by taking into consideration the location of such large customers and the character and magnitude of service required.

In this connection it is of interest to discuss the advisability of charging a higher rate for gas when used for lighting purposes than when used for heating and cooking. As a matter of fact by far the largest part of the consumption of gas is for purposes other than lighting, and this probably accounts for the fact that the rates for the two classes of service differ. In addition there is of course the fact that the use of gas for lighting concentrates the maximum demand somewhat similar to, although of less magnitude than, the use of electricity for lighting. Gas is stored in the holder with little additional cost as compared with the storage of electricity, so that the peake load character of the demand is decidedly of smaller consequence, as regards the maximum capacity of the plant, than in the generation and consumption of electrical energy. Whether use for lighting or fuel on the customers' premises the gas is used in the same way and from the same service pipes, and unless there is a very

great difference in the magnitude of consumption in the two cases it is difficult to see where lies the difference in the cost of service in the two instances.

Rate of Return on Investment.

What is an adequate return on the investment for a public utility corporation is a question that has been given the greatest consideration, not only by the courts of the country, but by Federal, State, Municipal and other commissions. In the U. S. Supreme Court decision in the Consolidated Gas Case of New York, it is stated that:

> "There is no particular rate of compensation which must in all cases and in all parts of the country be regarded as sufficient for capital invested in business enterprises. Such compensation must depend greatly upon circumstances and locality; among other things the amount of risk in the business is a most important factor as well as the locality where the business is conducted and the rate expected, and usually realized there upon investments of a somewhat similar nature with regard to the risk attending them."

In considering such a matter it is evident that under present industrial conditions the best interests of society as a whole are subserved when the share of each factor of production is high enough to cause a free and natural distribution of capital and business ability as well as labor into all utilities. When wages and the returns on investment are not high enough to be attractive then in such a utility there must be a decline. No utility will be furnished unless the factors making such a utility attractive are present. Wages must be high enough to attract competent workmen, salaries sufficient to engage successful superintendents and managers, interest on the capital legitimately invested must be earned, and, in general, the return must be high enough to induce investors to assume all risks and responsibilities that are involved in their operation. From this it naturally follows that the rate fixed for service rendered by public utility corporations must in the long run be high enough to attract all of the elements necessary for the production of that service, taking into consideration the wages to be paid, the cost of superintendence and management, the interest on the investment and a reward for the risk and responsibility entailed.

Unfortunately, however, many who have been most active in the development of public utility corporations in recent years have been interested therein primarily from the speculative standpoint rather than as legitimate investors. Speculation necessarily involves risk. An investment is generally considered reasonably safe. A high rate of return rarely compensates when there is a danger of losing a part or all of the principal. Customers of a public service corporation have a right to demand that the rates they pay for service shall be only adequate to give a proper return upon the necessary investment required, and not so high as to make the return, upon a reasonably safe investment, of the magnitude usually demanded in a pure and unadulterated speculative venture.

The tendency toward legislation affecting public utilities, the creation of wise and powerful commissions and the enactment of numerous laws not only regulating but actually protecting public service corporations constitute a definite reduction in the risks and hazards formerly existing in many instances.

In public utilities capital cannot be turned over as frequently as in commercial enterprises, due to the relatively large proportion of the fixed investment. Legislative regulation of public utilities through commissions may in some respects be detrimental to financial operators who endeavor to evade their obligations under the common law and who try to profit by the manipulation of capital rather than through legitimate, effective and economical operation of their plants. Such regulation, however, cannot possibly result in permanent injury to the great majority of investors and to the utilities themselves if honestly applied and administered with ordinary care. An investment along the lines of and in the spirit of such laws as those which have been upheld by the courts assures, in every case, a reasonable return on a fair valuation of the plant.

While public utilities are subject to many conditions that tend to increase the risks under which their business is carried on, they are also afforded a great deal of protection that is of the greatest value to investors. Many are natural monopolies engaged in furnishing service that has practically become a necessity and for which, at least at the present time, there are no effective substitutes. An investment in a public utility corporation wisely directed, while involving a greater risk than if the same money was placed in good mortgages, should not involve hazards equal to investments in ordinary competitive enterprises.

The profits of a business consists of the balance between the sum of expenses and the total income of the business. It is the difference between the sum representing the operating expenses, which includes rent, salaries and wages, fuel, taxes, interest, depreciation, and the total gross revenue. This difference is the last share of the total income and unlike all the other shares is not fixed. It simply consists of what is left after all other claims have been completely satified. Salaries, wages, rents and interest are usually fixed at a certain amount per annum in advance and are paid out of the gross receipts. The amount left after these shares have been satisfied belongs to the owner and represents his share of the profits of the business. Interest and profits, notwithstanding the indeterminate quality of the latter, are usually measured upon the same basis and are included in what is generally known as the adequate return on the investment.

The difference between the gross revenue and the aggregate of the legitimate operating expenses for a single year is the sum usually considered as the net revenue or return upon the investment. As the gross revenue and the operating expenses are for many reasons subject to wide variations, it is manifestly unsafe to determine rates upon a single year's business. A most valuable method is to consider the gross and net return per dollar invested for a number of years of operation. By doing this the additional investment in the plant from year to year as well as the growth of the business, both from the standpoint of gross revenue and operating expenses, is obtained. In fact, many important conditions affecting the company are brought to light in such an analysis.

The value of ascertaining how much a dollar earns, both gross and net, is due to the important differences between public service corporation and ordinary commercial enterprises. In most private un-

dertakings the operating expenses can usually be greatly reduced or even practically eliminated if for any reason the gross receipts are reduced so as to make the business unprofitable. But this cannot be done in the case of public service corporations, who must under the law provide service to all within the territory covered by the distribution system provided who request it. While the investment in the private enterprise may be greatly restricted or even withdrawn, such is not the case with a public service corporation. The relatively large investment in plant, equipment and other property of the public service corporation means that the interest and other fixed charges go on at about the same rate whether the plant is operated and its output sold or not. As a result, the public service corporation is compelled under certain adverse conditions to keep its plant in operation even if the actual operating expenses are greater than the gross receipts.

A complete investigation of all conditions existing for a number of years is therefore of much greater value than confining the data upon which rates are fixed to a single year's business. The public service corporation should not be a free agent to do absolutely as it pleases, and on account of this restriction certain reasonable protection is desirable for all concerned. Free and unrestricted competition between private enterprises may be of the greatest benefit to the public. Experience shows, however, that this is not the case with public service corporations where the commodity furnished by them is a necessity and the character of the business such as to be a natural monopoly. Competition in such cases inevitably results in a bitter struggle for supremacy and rates so low as to be inadequate to maintain the proper quality of service and yield a return sufficient to make extensions commensurate with the growth of the community. Two or more distinct and separate corporations providing the same public commodity are not likely to remain separate very long. Sooner or later it will be self-evident that the service rendered by them independently can be more cheaply, effectively and in a better manner provided by a single operating system under one management. As a result it is an invariable rule that competition which is often thought to be preventive of excessive rates becomes ultimately the direct cause of what is relatively extortionate rates of service, when compared with what the rates should be if destructive and temporary competition is prevented and the rates equitably fixed under proper control by a wise commission.

Again, a modification of rates at frequent intervals is undesirable, as it renders unstable and therefore the more hazardous the entire business of rendering service. Everything of every character tending to eliminate uncertainties and general risks on the one hand, and which provides protection and wise regulation on the other, definitely increases the security of the investment, the required return upon which is thereby reduced, the general stability of the enterprise is materially improved, restulting not only in reduced rates but improved quality of service.

Conversely, the rate of return on the investment and consequently the rates of service must be correspondingly high as long as unrestricted competition threatens, and extraordinary risks involving a possible loss of a large fraction of the investment confronts, those interested in the progress and development of public service corporations in general.

In the end, all costs of every character, such as litigation and other expenses, incident to the establishing of rates, whether paid out of public funds or by the public service corporations, come out of the customers' pockets, as taxpayers in one instance and as consumers forced to pay the company for service in the other. The constant danger to the company of having its investment as well as its gross revenue seriously impaired due to the fixing of rates upon other than a sound and equitable basis involves that much extra hazard in conducting its business, necessarily requires an increased return upon the investment on account of such menace, and in turn will ultimately result in rates higher than they should be.

Members in Attendance at the 19th Convention of the Pacific Coast Gas Association, Sept. 19, 20, 21, 1911, Oakland, Cal.

Adams, H. E.
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Armstrong, W. J.
Barry, W. B.
Basford, H. R.
Baurhyte, W.
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Kirk, Geo.
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Kohlwey, W. D.
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Kepplemann, D. E.
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Rix, A. J.
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2. Charles B. Babcock, Coast Representative, General Gas Light Co., San Francisco.
3. A. U. Brandt, Supt. Elec. Dist., Oakland Gas, Light & Heat Co., Oakland, Cal.
4. John A. Britton, Jr., Asst. Gas. Dept., Pacific Gas & Electric Co., San Francisco.
5. Mortimer R. Brown, Comcl. Dept., Oakland Gas, Light & Heat Co., Oakland, Cal.
6. S. S. Campbell, Comcl. Dept., Oakland Gas, Light & Heat Co., Oakland, Cal.
7. Roy Crossman, Asst. Gas Extension Dept., Oakland Gas, Light & Heat Co., Oakland, Cal.
8. Jack P. Davidson, Salesman, The W. F. Boardman Co., San Francisco.
9. D. H. Foote, Secretary, Pacific Gas & Electric Co., San Francisco.
10. Frank Gilbert, Comcl. Dept., Oakland Gas, Light & Heat Co., Oakland, Cal.
11. Frank H. Hess, Manager, Home Gas Co., Porterville, Cal.
12. F. A. Kales, Draftsman, Oakland Gas, Light & Heat Co., Oakland, Cal.
13. Geo. F. Maddock, Engineer, 2516 College Avenue, Berkeley, Cal.
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16. Chas. A. Rice, Gas Dept., Pacific Gas & Electric Co., Chico, Cal.
17. W. W. Shuhaw, Chief Clerk, Pacific Gas & Electric Co., San Leandro, Cal.
18. H. B. Squires, Otis & Squires, Mfg. Agents, San Francisco.
19. J. W. Terney, Foreman Gas Meter Dept., Oakland Gas, Light & Heat Co., Oakland, Cal.
20. P. C. Wickersham, Comcl. Dept. Oakland Gas, Light & Heat Co., Oakland, Cal.
21. Jas. H. Wise, Asst. Gen'l Manager, Pacific Gas & Electric Co., San Francisco.
22. W. W. S. Butler, General Manager, Western States Gas & Electric Co., Stockton, Cal.
23. Don A. Tregidgo, Asst. Dist. Dept., San Francisco Gas & Electric Co., San Francisco.
24. F. F. Barbour, Asst. to Pres., Pacific Gas & Electric Co., San Francisco.
25. F. H. Walker, Agent, Walker Stove & Range Co., San Francisco.
26. A. Emory Wishon, Asst. General Manager, San Joaquin Light & Power Co., Bakersfield, Cal.
27. H. A. Lemmon, Supt., Carson City Coal Gas Co., Carson City, Nevada.
28. M. G. Hall, Manager, Pacific Gas & Electric Co., Santa Rosa, Cal.
29. J. H. Hill, California Manager, Pittsburg Meter Co., San Francisco.
30. Edwin Letts Oliver, Manager Oliver Continuous Filter Co., San Francisco.
31. A. F. Derrick, Foreman, Oakland Gas, Light & Heat Co., Oakland, Cal.
32. F. J. Schaffer, Asst. Supt., Southern California Gas Co., Los Angeles, Cal.
33. E. A. Gimper, Supt., Bakersfield Gas Co., Bakersfield, Cal.
34. A. C. Davis, Gas Steam Specialties, San Francisco.
35. R. H. Burdick, Asst. Supt., San Diego Cons. Gas & Electric Co., San Diego, Cal.
36. Jos. S. Worthington, Supt., Municipal Gas Works, Santa Clara, Cal.
37. C. M. Crow, Div. Mgr., Pacific Light & Power Co., San Bernardino, Cal.
38. E. C. Demming, Supt. Gas Dist., Sacramento Electric, Gas & Railway Co., Sacramento, Cal.
39. H. H. Sprague, President, Sprague Meter Co., Bridgeport, Conn.

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2. F. P. Woy, Manager, Albuquerque Gas, Electric Light & Power Co., Albuquerque, N. M.
3. Geo. W. Ackerman, Salesman, Walker Stove & Range Co., San Francisco.
4. Reliable Eng. & Mfg. Co., Pasadena, Cal.
5. Oregon Power Company, Eugene, Ore.
6. McGeorge & Cooper Mfg. Co., 322 Sheldon Bldg., San Francisco.

REPORT OF SECRETARY AND TREASURER.

September 11th, 1911.

Balance on hand—		
General Fund		$ 195.11
Library Fund		388.18
Total		$ 583.29
Dues	$1,745.00	
Initiation Fees	290.00	
Badges	2.50	
Miscellaneous acct. Bank Interest	3.63	
Sale of Volumes	13.50	
Volume No. 6, advertisements	579.25	
18th Meeting, from Journals, acct. reporting fees	75.00	2,708.88
Total receipts		$3,292.17
Expenses 18th Convention	$1,528.30	
Purchase of books, etc., for library	123.01	
Expenses Secretary's Office	434.07	
Printing and Mailing Volume No. 8	928.19	3,013.57
September 11, 1911. Balance on hand—		
General Fund	13.43	
Library Fund	265.17	278.60
		$3,292.17
Volume No. 8—		
Cost of Printing, postage, etc	$ 928.19	
Less, acct. advertisements	579.25	
Net cost of Volume		$ 348.94
Badges—		
On hand September 10, 1910	2	
Sold	1	
On hand September 11, 1911	1	
Membership—		
On Books—Regular Members	212	
On Books—Associate Members	68	280
Elected 18th Meeting, Sept. 20, 1910—		
Regular	68	
Associate	15	83
Total Membership		363
Resigned	9	
Dropped	9	18
Total Membership, Sept. 11, 1911		345
Honorary	3	
Regular	268	
Associate	74	

LIST OF VOUCHERS.

No.	Favor Whom. Account.	Amount.
1.	Bostwick, postage and stationery	$ 34.75
2.	Mercantile Bank, collection charges	2.20
3.	Payot, Stratford & Kerr, stationery and printing	71.50
4.	Pacific Photo Art Co., half-tone prints	8.25
5.	Lederer-Street & Zeus, stationery	15.62
6.	S. F. G. & E. Co., acct. telegraph tolls	1.75
7.	H. Bostwick, salary Sept., 1910, to Aug., 1911	300.00
8.	P. G. & E. Co., acct. telegraph tolls	3.00
9.	Shreve & Co., medal	65.00
10.	Wells, Fargo & Co., express charges	4.80
11.	H. Bostwick, expenses attendance 18th meeting	68.15
12.	Hotel Alexandria, banquet 18th meeting	975.00
13.	H. H. Harris, reporting 18th meeting	109.90
14.	Pease Bros., use of furniture 18th meeting	3.50
15.	C. S. Vance, miscellaneous expenses 18th meeting	31.50
16.	Brunt Co., menu and program	96.35
17.	Wm. Schade, miscellaneous expense 18th meeting	12.10
18.	Whitehead & Hoag Co., badges 18th meeting	112.00
19.	Auditorium Co., rent of hall 18th meeting	40.00
20.	C. S. Vance, telegram	2.00
21.	H. Wilson, stenographer	5.00
22.	Philadelphia Book Co., books, library	49.50
23.	J. Costa, premium insurance policies	10.80
24.	Wells Fargo & Co., express charges, books	1.65
25.	Keuffel & Esser Co., acct. library	13.50
26.	Isaac Upham Co., acct. library	12.00
27.	Progressive Age, acct. library	3.00
28.	Gas World, acct. library	4.79
29.	Progressive Age, acct. library	3.00
30.	Gas Industry, acct library	2.00
31.	E. C. Brown, copy Brown's Directory	5.27
32.	Payot, Stratford & Kerr, acct. library	17.50
33.	Payot, Stratford & Kerr, printing Volume No. 8	880.24
34.	American Dist. Tel. Co., messenger service	5.½0
35.	Technical Pub. Co., cuts, etc., Volume No. 8	42.35
		$3,013.57

Resignations.

Regular.

1. Wm. Angus ..... San Leandro, Cal.
2. A. Cartley ..... Honolulu, T. H.
3. Chas. R. Collins ..... Seattle, Wash.
4. Vanderlynn Stow ..... San Francisco, Cal.
5. F. L. Wright ..... Prescott, Ariz.

Associate.

6. Sam Heyman ..... San Francisco, Cal.
7. Long Beach Gas Co. ..... Long Beach, Cal.
8. San Joaquin Light & Power Co ..... Fresno, Cal.
9. Suburban Electric Light Co ..... San Leandro, Cal.

Members Dropped.

Regular.

1. O. F. Anderson ..... Los Angeles, Cal.
2. Ira C. Carter ..... Honolulu, T. H.
3. Edw. Steinmueller ..... Chicago, Ill.
4. A. E. Hursh ..... Selma, Cal.
5. H. L. Delaney ..... San Francisco, Cal.

Associate.

6. C. O'D. Blanchfield ..... San Francisco, Cal.
7. Godfrey Fritz ..... Los Angeles, Cal.
8. Chris Sieber ..... Woodland, Cal.
9. McCormick-Henderson Co. ..... San Francisco, Cal.

JOURNAL OF ELECTRICITY
POWER AND GAS

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Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas." Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

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A Public Service Corporation Man's Attitude

Public opinion and more especially public desires and ambitions in proposed relationships of the municipality with the public service corporation are as vacillating as the fads which create the fabulous Belgian hare industries one year and starve them to death the next. When not properly directed, desires and ambitions on the part of the public will retard municipal growth and the freedom of natural progress as surely as the fashions of the day hobble the energies of our women. Not only do these fashions hobble the women in their personal attire, but they waste enormous energies in public agitation as was done in the city of Rochester in an endeavor to change the heights of street car steps to meet the hobbled skirt limitations. Thus it is in case of the municipality, often misdirected public activity will lead a community into waste of energies which properly applied would have many fruitful results.

There are cases on record where the municipal ownership of public utilities has proved a marked success. There are many more which, by the careful juggling of the annual statements of receipts and expenditures, the fat office-holders have made the public believe are a success.

Be all this as it may. The fact remains that at intervals during the life of a municipality, the municipal ownership idea creeps heavily into the issues of political struggles. How often it has been found in the past that the ever jealous corporation has either concealed its records when the public demanded an open statement, or, due to almost criminal neglect of business methods on the part of the corporation, an accurate statement has been impossible.

At the recent Oakland convention of the Pacific Coast Gas Association, Professor C. L. Cory of the University of California presented a paper on the fixing of rates, which for its fairness, both to the public and to the corporation, was of remarkably high order. John A. Britton, who is general manager of one of California's most powerful corporations—namely the Pacific Gas & Electric Company—followed in the discussion of the paper. It was a treat to all those within his hearing to listen to Mr. Britton's remarks. Commenting first upon the able manner in which Professor Cory had handled his subject, he urged upon all corporations to have expert appraisements made of their holdings and their books in such accurate and accessible form that any call for public inspection by experts could easily and quickly be met. Mr. Britton's idea conveyed was that the inability of a corporation in the past to show a clean, accurate statement, had always been misinterpreted by the general public and taken by the public to mean that the public service corporation had something to conceal.

Mr. Britton was quite right when he made the statement that public uneasiness was largely brought

about by this element of supposed holding back on the part of the great corporations. Mr. Britton struck the keynote. Such breadth of view shown by a representative of a great public service corporation will do much toward the creating of a more wholesome understanding between the public service corporations and the public.

Puget Sound Rate Case

Elsewhere in these columns will be found an account of the recent court decisions affecting traffic rates within twelve miles of Tacoma and Seattle on the Puget Sound Electric Company's service.

The ruling is one of great importance and its influence will be widely felt in rate questions in the west. The court takes the ground that 7 per cent is not an unreasonable return on an investment; that mistakes of the company in the past cannot be assessed to the traveling public. The last statement was made in response to the showing that the company had not in the past set aside a proper sum to cover depreciation.

In the adjustment of traffic matters and the fixing of rates by a commission, many things must be brought into consideration. The only method that will give justice to both sides of any controversy is for the arbitrator to put himself as far as possible in such a frame of mind that both sides to the issue can be seen. In a word, great public service corporations have been running along for years untrammeled by any definite public regulations. Now comes the commission which intervenes according to recent laws. In readjusting matters, surely reasonable errors made in the past must be allowed for in the re-adjustment. Any individual engaged in the busy run of life will recall in a moment's thought what an enormous portion, even compared to the total outlay, is actually wasted by mistakes in launching any enterprise. Such mistakes, from our very makeup as human beings, seem to be unavoidable. In a calm, just, reasonable striking of a balance they should represent an intangible asset to the owners of a project, not as representing an interest account on a blunder which an unwieldly corporation desires to saddle on the long-suffering public, but as representing in good faith a certain capitalized amount of human brains and genius finally successful in overcoming human difficulties met in the evolution of an art.

The case is comparable to human attempts in the solution of a new mathematical problem. At first the subject is wholly unknown to us. We read, and we figure, making many mistakes as we go until finally after hours of laborious work, our task is complete. In the future progress of our engineering career we use the same identical problem thousands of times, but ever thereafter it only takes us a few minutes for the proper solution. Surely it is proper and right for the expert to charge for his services not only during the brief period now required in its solution, but also the interest on a certain capitalized valuation of the application of his brains and of experiences acquired from former mistakes and efforts.

Thus it is true that in making a proper valuation of any public service corporation, justice should give to the corporation a reasonable capitalized asset as representing in its particular case the proper amount in expenditure that the human element necessitated in overcoming human shortcomings met with in the advancement of the art.

The Big Meadows Dam

Elsewhere in these columns will be found a description of the proposed Big Meadows dam of the Great Western Power Company. This enterprise means the launching of an additional supply of power in enormous quantities. The project is an interesting one, first as an engineering undertaking, for it is said that the cost per acre foot of storage will be less than any other dam in the world of similar large proportions. The impetus given to large storage projects in the West during recent years has brought about a deep realization on the part of capital of the gigantic possibilities of such projects. It is said that Daniel Webster once opposed the appropriation of moneys on the part of the government for the erection of a fort along the coast of Oregon, concluding a brilliant opposition speech by saying: "Mr. President, what can we ever hope to do with this useless territory but a home of the sage brush and the jackrabbit" Long since brother Dan would have turned in his grave could he but realize the fallacy of his remarks.

In Egypt the late improvements on the Assouan dam have increased the storage capacity so that it stands first in the world; next in capacity is the Roosevelt dam; and the Big Meadows dam will rank third in similar engineering undertakings of the world.

The most interesting feature, however, is the useful purpose the storage of such enormous quantities of water will serve in carrying the burdens of the human race. The water will be used over and over again in its descending course from the mountains. Five great diversion projects will impede its onward way, developing thereby a total of over 500.000 h.p.

Hitherto the great agricultural valleys below have been subjected to hazardous floods in extremely moist years, brought about by the onslaught of run-off waters and waters caused by the melting snows in the high Sierras. The retaining of such an enormous flood storage in the mountains will do much to alleviate this condition.

Finally, having reached the beautiful stretch of agricultural country of central California in regulated quantities, the waters will once again be used to quench the thirst of thousands of acres of semi-arid lands, thus again blessing the State by its presence.

PERSONALS.

Henry E. Adams, a lighting official of Stockton, was a recent San Francisco visitor.

L. E. Waird, an electrical engineer of Sacramento, spent last Sunday at San Francisco.

J. C. Farrar, of J. C. Farrar & Co., electrical engineers, Los Angeles, was a recent San Francisco visitor.

Ely C. Hutchinson, of the Pelton Water Wheel Company's sales force, is spending a vacation in the redwoods.

Guy H. Talbot, president of the Pacific Power & Light Company of Portland, Ore., was at Tonopah, Nev., during the past week.

A. H. Babcock, chief electrical engineer of the Southern Pacific, spent the past week at Portland and other points in Oregon.

S. Waldo Coleman, manager of the Coast Counties Light & Power Company of Santa Cruz, was a recent visitor to the Bay cities.

J. L. Randolph, president of the Turlock Telephone Company, recently arrived from Turlock and spent a few days at San Francisco.

H. B. Hernford, who is connected with the Pacific Gas & Electric Company, with headquarters at Chico, was a recent San Francisco visitor.

J. M. Berkley, superintendent of the Southern California Gas Company, has returned to Los Angeles after spending a few days at San Francisco.

J. H. Wise, assistant general manager of the Pacific Gas & Electric Company, has just returned to San Francisco, after a trip to the site of the propcsed Lake Spalding dam.

F. B. Gleason, manager of the Western Electric Company's San Francisco branch, recently returned from the East and is now on a trip through the interior of the State.

L. J. Corbett, hydraulic and electrical engineer, Spokane, Wash., has entered university work as Associate Professor of Electrical Engineering, at the University of Idaho, Moscow.

Sydney Sprout left last Monday for Siskiyou County on business connected with the construction of the Siskiyou Electric Power & Light Company's new hydroelectric development on the Klamath River.

K. G. Dunn, electrical engineer with Hunt, Mirk & Co., returned to San Francisco during the past week, from San Diego, where some important work is in progress for the San Diego Electric Railway Company.

John A. Britton, Jr., son of the well known public service corporation man bearing the same name, recently joined the Pacific Coast Gas Association and was blushingly introduced to the convention as a "chip off the old block."

O. C. Pratt, president of the Indian Valley Electric Light & Power Company, recently returned from a trip to Greenville, where improvements in the hydroelectric system are contemplated in view of the future possibilities of that section.

H. R. Noack, manager of Pierson Roeding & Co., announces that the firm will remove their offices from the Monadnock Building to the Rialto Building. A large space will be occupied on the ground floor at the corner of New Montgomery and Minna streets.

C. W. Forbes, general manager of the Sonora Telephone Company of Sonora, Mexico, is at San Francisco taking bids on a long distance telephone line, extending from Guaymas to Hermosillo. The cost of the pole line alone is estimated at about $40,000. The telephone equipment will be of high quality throughout.

E. O. Sessions of the Chicago engineering firm of Woodmansee, Davidson & Sessions, Inc., is a recent San Francisco visitor. Mr. Sessions is receiving congratulations of his many engineering friends on the able and efficient skill he has shown in the installation of the Long Beach Plant of the Southern California Edison Company.

Among the passengers on the steamer Maitai, which arrived Thursday was J. D. Douglas, manager of a suburban railway line out of Auckland. He is figuring on electrifying the system and has come to the United States to inspect the electric lines here. The new cars will be built in New Zealand, but all the machinery will be imported.

Wallace Foster of the San Rafael gas division, and Stanley Walton, of the commercial department of the Pacific Gas & Electric Company, are blushingly receiving the congratulations of their many friends over their tragic efforts in the burlesque council meeting held during the recent banquet of the Pacific Gas Association, in Oakland.

Carl D. Heise, who has long held a prominent position in the Pacific Coast sales department of the Westinghouse Electric & Manufacturing Company, has just been appointed as acting manager of the San Francisco district office. Wallace W. Briggs is now assistant sales manager of the company, with jurisdiction over the San Francisco, Los Angeles and Seattle offices. Although young in years, Heise is old in electrical experience. After taking an engineering course in the University of California he entered the San Francisco office of the Westinghouse Company and was soon installing hydroelectric plants in the early days of high-tension transmission work. After several years of field experience, he rejoined the sales force and the management has now shown its appreciation of his work.

TRADE NOTES.

The Great Northern Railway, which already has nearly 4000 miles of track equipped with telephone train dispatching equipment, has just placed an order with the Western Electric Company for thirty-two telephone selectors to equip its Cascade division.

The Union Iron Works Company of San Francisco have this week closed an order with W. G. Douglas, of Virginia City, Nevada, for one water wheel unit to be direct connected to an electric generator. This wheel will develop 500 h.p. under 1000 ft. head running 600 revolutions.

The Vancouver Power Company's new hydroelectric plant, on the Jordan River, forty-three miles from Victoria, turned over for the first time last Sunday. The 3000-kw. generator was built by the Allis-Chalmers Company and installed by Sanderson & Porter under the supervision of Wynn Meredith.

The following electrical equipment has been ordered by the Oakland & Antioch Railway Company, San Francisco, Cal., from the Westinghouse Electric & Manufacturing Company: 4 quadruple equipments No. 321 motors, 600-1200 V. U. S. control; 1 quadruple equipment No. 322-E motors; 1 locomotive equipped with 4 No. 308-B-6 motors.

The Pennsylvania Railroad Company has recently ordered fourteen Western Electric selectors for use in its Hudson tunnels. The section equipped is known as the Jersey City-Newark Division, and it is nine miles in length. The dispatcher will be located at what is known as the "S. C." tower, and No. 16 B. & S. copper line wire will be used.

The Fort Wayne Electric Works supplied the electrical equipment, totaling 250 h.p. in induction motors, for the mill of the Stockton Mealfalfa Company of Stockton. The new plant, located at Salida, is the largest alfalfa meal milling installation in the State of California. The milling machinery was supplied by the Williams Pulverizer & Crushing Company.

INDUSTRIAL

THE LAST WORD IN INDUSTRIAL LIGHTING EQUIPMENT.

While the past types of Holophane-D'Olier steel reflectors practically solved the industrial lighting problem by providing units of extremely high efficiency and wide applicability, there are certain conditions where those reflectors with their aluminum finish are unsuitable on account of deterioration due to acid fumes or excessive dirt or exposure.

It was with a view to meeting these adverse conditions that the Holophane Company perfected a new line of steel reflector having a tough enamel finish and with the holders and connections of copper.

These new reflectors here illustrated are finished both inside and out with a white enamel. This enamel is not affected by chemical fumes or by weather conditions and is very easily cleaned, which means that there is no corroding or other deterioration.

They are furnished with the extensive type of light distribution.

Three holding devices are now available for use with Holophane-D'Olier Reflectors. The clip spring holder is well known, being the type that has hitherto been supplied exclusively; a new 2¼ inch heel which admits using the steel reflectors with standard holders, and a porcelain socket holder which allows the use of steel reflectors in many installations where brass sockets are not permissible, are now supplied also. These holders as before stated are copper finished and are of a sturdier construction than those heretofore used.

The Holophane Company has just issued a very attractive leaflet covering its new enameled reflectors, in which complete data is given.

NEW WATTHOUR METERS.

The Thomson watthour meters—Type I-10, recently developed by the General Electric Company, are designed for 5 and 10-ampere, 100 to 120-volt, 2 wire and 200 to 240-volt, 2 and 3 wire, 40, 50, 60, 125 and 133-cycle circuits.

New Thompson Watthour Meter—Casing Closed

Their mechanical and electrical design represents the most advanced stage of the meter art—the former insuring light weight and compact and rugged construction, the latter affording great accuracy of measurement under the voltage, frequency, wave form and temperature variations ordinarily occurring on lighting circuits, and also, shielding the meter element from any stray fields liable to be encountered in ordinary practice.

The rotating element consists of a small aluminum disk mounted on a bronze shaft. The lower end of the shaft carries a removable steel pivot, the upper end has the worm for transmitting the motion of the disk to the registering mechanism. The upper and lower bearings are carried on an aluminum frame casting, which also supports the magnet and registering mechanism, thereby insuring permanent alignment. The upper bearing consists of a steel pin fastened to a removable brass plug and extending down into the rotor shaft, which is drilled to receive the same. The lower bearing is a selected Oriental sapphire mounted in the top of the

New Thompson Watthour Meter—Casing Opened

brass screw and resting on a spring. A brass collar at the top of the jewel screw prevents the pivot from jumping off the jewel surface and riding on the top edge of the jewel screw, in case of extreme short circuits or other violent disturbance. The pivot is made of highest grade piano steel hardened and polished. It is screwed into the lower end of the shaft so as to permit of its being readily replaced if necessary.

The register is of the three-dial type reading directly in kilowatt-hours, no multiplying constant being necessary. One complete revolution of the most rapidly moving pointer registers 10 kilowatt-hours, therefore, 1000 kilowatt-hours must be registered before the dials repeat. The dial face is of white porcelain having a dull finish. The registering mechanism is of such construction that it may be removed for resetting the dials, repairing the meter, etc., and be replaced without disturbing the mesh of the train of gears.

The permanent magnet controlling the full load speed of the rotating element is of semi-circular form and completely surrounds the register. The magnet is made of the very best magnet steel properly aged and hardened to insure absolute permanency. It is so assembled on the frame that the opening between the poles is brought close to the upper surface of the aluminum disk. The arrangements for regulating the full load and light load speeds afford great refinement in adjustment. Creeping on potential alone is entirely prevented. The meters are lagged by means of a copper punching, which acts as a short circuited secondary for the flux of the potential coils, and therefore, the meters will give satisfactory results in the measurement of inductive as well as non-inductive loads.

The terminals comprise four brass binding posts located

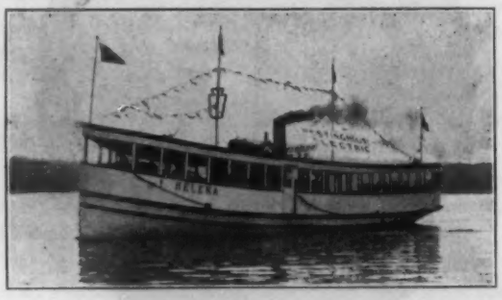
in a separate compartment made of moulded insulating compound, and fastened to a projecting part of the meter base. The terminals can be separately sealed, and the method employed for fastening the meter to the wall effectually prevents it being removed for the purpose of tampering.

For convenience in testing prior to installation, a testing loop is brought out through the frame just below the magnet. Any number of meters may be tested in series, without recording the losses in the potential circuits, by connecting the potential coil of each meter to the source of potential at some point before the line wires enter the meters.

The cover is drawn from zinc alloy, the bottom being threaded to fit in a groove in the meter base ,and when screwed firmly into place makes a perfectly dust-proof joint. Suitable means are provided for sealing the cover as well as terminal box.

EXHIBIT ON STEAM LAUNCH.

One of the most interesting and novel features of the Pennsylvania Electrical Association Convention at Conneaut Lake, Pennsylvania, was the floating exhibit of the Westinghouse Electric & Manufacturing Company. This consisted of a seventy-foot steam launch.



A New Idea for Commercial Exhibits.

A complete line of electrical cooking and heating devices were displayed on the boat. Among these were chafing dishes, toaster stoves, coffee percolators, electric irons, radiators, glue pots, heating pads, nursery milk warmer, and a dentist's and physician's sterilizer.

ELECTRIC LOCOMOTIVES FOR THE TERRE HAUTE, INDIANAPOLIS & EASTERN TRACTION CO.

Many unique features are incorporated in the 240 h.p., 30-ton, all-steel electric switching locomotives (see Fig. 1), designed and built by the Terre Haute, Indianapolis & Eastern Traction Company at its Indianapolis shops.

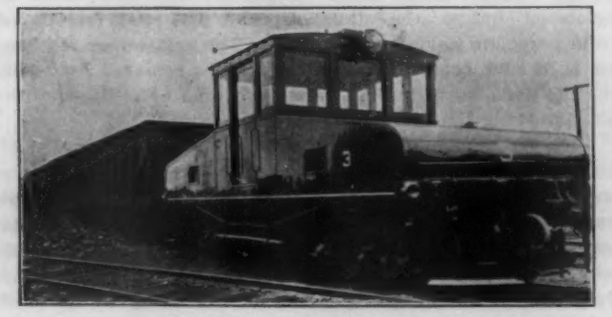


Fig. 1. Electric Locomotive on the Terre Haute, Indianapolis & Eastern Traction Co.

HL control equipment was selected for the locomotive because of its ability to continuously and reliably handle the large currents incident to shifting heavily loaded cars. With switching locomotives there are, necessarily, frequent applications of the controller to the first and second notches; that is, there is almost a continuous breaking of heavy currents. Because of this, HL control is preferable to the K types for such service. A further advantage of HL control for locomotive work is that the controller occupies but little space in the usually crowded cab and leaves plenty of room for the operator to step about and look out on all sides.

The switch group for the control and the reverser are mounted under one of the sloping hoods at one end of the cab, while the compressor and other air brake details, with the exception of apparatus that must be available for manipulation, are mounted under the other. The grid resistors for the control are mounted underneath the car. Small incandescent lamps for illuminating the air gauges in the cab are in circuit with lamps arranged in the hoods. This arrangement facilitates inspection of the equipment.

IMPROVED STENCILS FOR THE ELECTRIC SIGN PROJECTOR.

An entirely new electric sign as often as you desire at the nominal cost of fifty cents gives users of the Electric Sign Projector an opportunity to advertise special sales and new arrivals in an economical and effective manner right at the store front.

The sign projector, as the name implies, is not an electric sign but a device for projecting a sign from the window onto the sidewalk or on the side of a wall. The result is much the same as if a glass covered electric sign were imbedded in the sidewalk.

The sign is produced by greatly magnifying a small stencil. To improve the process of manufacturing so as to turn out stencils in large quantities at reduced cost was the first problem that presented itself to the manufacturers after the device was perfected. This problem has been so satisfactorily solved that stencils may now be procured in any quantity on short notice and at the small cost of fifty cents each.

NEW CATALOGS.

Duncan Direct Current Watthour Meter is the title of Bulletin No. 20 just published by the Duncan Electric Manufacturing Company of Lafayette, Indiana. The book is neatly printed and covers the subject thoroughly.

Bulletins Nos. 55 and 56 of the Richardson-Phoenix Co. have just made their appearance in the trade. The former deals with individual oiling and filtering systems, while the latter discusses fully the Economic Elevator Guide Lubricator. Both publications are interesting and profitable reading matter in addition to their value as catalogs.

The Westinghouse Electric & Manufacturing Co. has just issued a series of new bulletins. No. 1028 deals in Westinghouse rotary converters and No. 1190 is entitled Westinghouse Engine Driven Alternating Current Generators Type E. Five neatly printed folders dealing with Westinghouse electric tailor's iron, a.c. switchboard meters, d.c. switchboard meters, watthour meters, type OA, and type C watthour meters are also making their appearance among the trade.

TRADE NOTES.

S. Glen Vinson, vice-president and general manager of the Ideal Electric and Manufacturing Company of Mansfield, Ohio, has been visiting the Pacific Coast for the past three weeks with a view to establishing a branch house in the West.

R. B. Elder, vice-president and general manager of the Machinery and Supply Company, has resigned his position with this company to take charge of the branch house of the Ideal Electric and Manufacturing Company of Mansfield, Ohio, in this city. Location of office will be given in a later issue of the Journal.

NEWS NOTES

FINANCIAL.

OAKDALE, CAL.—Sealed bids were received by the clerk of the Board of Trustees up to September 18, 1911, for the purchase of $25,000 of water bonds and $12,000 of sewer bonds.

MORGAN HILL, CAL.—The Morgan Hill municipal bonds for a water system have been sold to the Bank of Morgan Hill for $13,334.80. They are bringing a premium of $334.80.

TACOMA, WASH.—A $10,000,000 mortgage has been filed by the Tacoma Gas Company with the county auditor in favor of the Continental Commercial Trust Company and Savings Bank of Chicago. The money is to be used for new improvements and an extension of the service.

VALLEJO, CAL.—There will be a bond election held late next month or early in November on the question of whether or not an issue shall be made providing for a municipal electric light plant and distributing plant. Also for the erection of a city hall and joint county jail; $150,000 will be voted for the electric light system and $75,000 for the city hall and jail.

ELKO, NEV.—Mr. Meyers, the representative of the Western Assets Company, the German branch of the Rothchilds, says that the town of Contact has a bright future. The company gets a 25 per cent interest in all the claims in the Contact district and in return will erect an electric smelter and build a railroad from the camp to the main line of the Southern Pacific railroad at Valley Pass, near Cobra. They will put in a big dam on the Little Salmon River and install a power plant to generate electricity to run the mines and smelter; the estimated cost of the plant, railroad, smelter and dam, being about $4,000,000.

ILLUMINATION.

BREMERTON, WASH.—The City Council has granted a franchise to Oroville Randolph and others of Seattle to construct and operate a gas plant in Bremerton.

SAN DIEGO, CAL.—The gas and light company is planning to lay mains and supply Ocean Beach with gas by the middle of October.

WALLA WALLA, WASH.—Mayor Cropp in a message to the municipal council of this city favored the immediate construction of a municipal power plant.

SEATTLE, WASH.—The Lighting Department of the city will erect a $9000 one story concrete power plant at 1179 Eastlake avenue. B. H. Graff, 601 American Bank Building, contractor.

SAN DIEGO, CAL.—The City Heights Improvement Association has been made a permanent organization and Walter Kirby has been made president. It has been decided to immediately install an electric street lighting system. Arrangements have been made with the San Diego Gas & Electric Company.

AUBURN, CAL.—J. L. Bryson, owner of the Rawhide mine at Towle and the Home Picket mine at Last Chance gives out the information that the deal has been finally closed whereby the Placer Electric Company, recently organized has become half owner of Bryson's property, together with other water ditches and rights. Bryson says he is to receive $1,240,000 for his half interest. The company plans to put in a big power plant on the American River near here.

SPOKANE, WASH.—City Engineer McCartney has received plans prepared by Architect K. K. Cutter for lamp posts on the Monroe street bridge. The plans will be inspected and steps taken to have the lamps manufactured.

KLAMATH FALLS, ORE.—The City Council has passed an ordinance granting to the W. F. Boardman Company a franchise for a period of 50 years for the erection and maintenance of a gas plant within the city of Klamath Falls.

SANTA BARBARA, CAL.—The Board of Supervisors will receive sealed bids up to October 16, for the purchase of a franchise granting the right to construct, and for a period of fifty years to maintain a system of gas pipes under and along the public roads and highways of the county.

RIVERSIDE, CAL.—The Ornamental Cement Stone Company has closed a contract with the Panada Development Company to make 70 concrete lamps to be used at the new mission town of Panada in Merced County. These will be old mission plan and cost several thousand dollars.

LIVERMORE, CAL.—Officials of the Pacific Gas & Electric Company visited this city last week to plan the erection of an extensive gas manufacturing plant for supplying the product to Pleasanton and Livermore for light and heat. General Superintendent P. C. Funk and President John de Sabla visited Livermore on the matter and held a number of conferences. The plant is to be one of the largest in this part of the State.

PORTERVILLE, CAL.—With a cash capital of $1,000,000 and with headquarters in Porterville, the organization has been completed of the Central Counties Gas Company of California, the consolidation of gas plants of the southern portion of the valley, which will furnish illuminating and fuel gas to Terra Bella, Porterville, Strathmore, Lindsay, Exeter, Visalia, Tulare and probably Lemoore and Hanford. Frank Hugh Hess, the organizer and manager of the Home Gas Company, of Porterville, who was one of the promoters of the consolidation as well, has been elected president and general manager of the new corporation. Bonds will be issued against the physical valuation of the company in amount sufficient to construct high pressure gas lines, which will be necessary to cover the territory.

INCORPORATIONS.

SEATTLE, WASH.—The Sound Electric Company of Seattle has been incorporated for $10,000 by E. Ellsworth, H. Schacht and Ed. Ellsworth.

ESCONDIDO, CAL.—The San Diego County Mutual Telephone & Telegraph Company is the name of a new telephone company incorporated here for $100,000.

OLYMPIA, WASH.—The Twisp Valley Power & Irrigation Company of Twisp has been incorporated with a capital stock of $20,000 by Harry Burke and C. F. Lohman.

PORT TOWNSEND, WASH.—The Olympic Electric Railway Company has been incorporated with a capital stock of $2,500,000. The road is to be completed with the funds from the sale of $2,000,000 in bonds.

ALBANY, ORE.—Articles of incorporation of The Sweet Home Water Company have been filed in the county clerk's office. The object of the company is to furnish water for domestic and other purposes to the citizens of Sweet Home. The capital stock of the company is $20,000. The incorporators are R. Watkinds, W. A. Malone, A. School and J Goings.

PORTLAND, ORE.—The Ewbank Power Transmission & Motor Company, with a capital of $250,000, has been incorporated and articles filed. This concern is to equip and construct electric street car lines and develop and furnish power. H. Ewbank, Jr., H. B. Ewbank, Sr., and G. Staples are the incorporators. The principal place of business is Portland

TELEPHONE AND TELEGRAPH.

SUSANVILLE, CAL.—The Johnstonville Telephone Company has been granted a franchise to erect and maintain a telephone system for a period of five years.

NAPA, CAL.—The Monticello people with the co-operation of the Cappell and Wooden Valley residents and the business men of Napa, are contemplating putting in a direct phone line between their town and this city.

PETALUMA, CAL.—W. D. Thomas, the electrician, has been awarded the contract to build the telephone line for the Gugielmetti Telephone Company to Cotati. The line will commence at the J. D. Ellis ranch and extend to the Jarvis ranch at Cotati.

RED BLUFF, CAL.—The Tehama County Telephone Company has ordered two carloads of poles to be used in erecting the farmers lines. More poles will be ordered as soon as the number needed can be estimated. These lines will connect with the central stations at Red Bluff and Corning.

LOS ANGELES, CAL.—Conclusion of negotiations are announced whereby another independent telephone company has been added. This latest connection was made at San Fernando, and over three hundred subscribers in that town and its surrounding territory are given the benefit of the Pacific long distance service. Likewise all subscribers of the Bell company now have direct communication with every telephone working out of the San Fernando exchange. The connection is similar to that put into effect August 1 with the Home Telephone Company of Covina, operating at Covina, Azusa, Glendora, Puente, Bassett, Rowland, Irwindale Charter Oak and Baldwin Park.

TRANSMISSION.

WEAVERVILLE, CAL.—The Board of Supervisors has granted permission to the Trinity Dredging Company for a franchise for an electric transmission line for a period of fifty years over highways and bridges.

SAN BERNARDINO, CAL.—The Board of Supervisors has passed an ordinance granting to the Pacific Light & Power Corporation a franchise for a period of 50 years, to operate and maintain an electric pole and wire system upon all public roads and highways of the county, outside of incorporated cities.

LOS ANGELES, CAL.—F. A. Raney, vice-president of the Riverbank department of Guy M. Rush Company, has just returned from Riverbank and states that contracts have been let and arrangements are being completed for the installation of transformers and sub-stations to furnish light and power to that section.

SUSANVILLE, CAL.—The Board of Trustees has passed an ordinance granting a franchise to erect, construct and maintain poles and wires for the transmission of electricity for heat, power and light under or upon the highways within the corporations of Susanville for the purpose of conducting a general power and lighting business within the town.

BLAINE, WASH.—The British Columbia Electric Railway Company, headquarters at Vancouver, B. C., has secured an acre site on the international boundary line for the establishment of a large concrete electric station to furnish electrical energy to this city. J. Edward Waller, the London civil engineer, has reported favorably on the project and contracts are being arranged.

SAN FRANCISCO, CAL.—The Chamber of Commerce of San Francisco is in receipt of a circular proposal from the Isthmian Canal Commission, calling for bids to furnish a plant and materials for a hydroelectric station at Gatun. Sealed bids will be received at the office of the general purchasing officer of the Isthmian Canal Commission, Washington, D. C., not later than 10:30 a. m. on October 9. Further information can be obtained at the office of the Chamber of Commerce of San Francisco, Merchants' Exchange building.

TRANSPORTATION.

LOS ANGELES, CAL.—The Board of Supervisors has sold a franchise to the Pacific Electric Company for certain roads in the Yerba & Paige tract, at the usual bid of $100.

NORTH YAKIMA, WASH.—Pinner & Griffith, 810 E. Yakima ave., this place, have secured the contract for erecting the plant of the Pacific Power & Light Company at this place, at $23,400.

SEATTLE, WASH.—W. H. Coughlin, American Bank building, has been granted a permit by the Board of Public Works for the clearing and grading of right of way for the Lake Burien and Oxbow electric railways.

GOLDENDALE, WASH.—The Pacific Light & Power Company has been granted a franchise by the county commissioners to construct a power line from this place to Centerville, a distance of seven miles, to cost $7000.

MONROVIA, CAL.—A committee from the Board of Trade, consisting of W. H. Evans and Thomas Bynum, has called on Messrs. Shoup and McMillan, officials of the Pacific Electric Company, in regards to an electric line for this city.

NATIONAL CITY, CAL.—Work will soon start on the relaying of the track of the electric division of the San Diego Southern Railway, between National City and San Diego. New ties will be put in and all the old light rails will be replaced with new 65-pound steel rails.

SEATTLE, WASH.—The Hofius Steel & Equipment Coming steel rails sufficient for 10 miles of trackage on the proposed Seattle-Tacoma short line, the general contract for which has been secured by the Homer Crosby Construction Company. Construction work on the railway will begin as soon as the steel is delivered.

SAN JOSE, CAL.—C. P. Anderson made application recently to the Supervisors for a franchise to build a railroad between this city and Almaden. The bidders want to run a double track line with steam, electric or gas cars or all. The proposed railroad will be built, it is announced, at a cost in the neighborhood of half a million dollars. The project has been financed and the preliminary surveys already made, according to Anderson's statement through his attorneys to the board.

SAN FRANCISCO, CAL.—The Supervisors have passed the bill authorizing the Board of Public Works to purchase 40 acres for the Geary street municipal railway, the entire cost not to exceed $350,000. The board also authorized the payment of $6900 to Eccles & Smith for 60,000 tie plates furnished for the Geary street railroad. The board laid over until a later date the matter of approving the "loop terminal" for the Geary road, recommended by Public Works Commissioner Laumeister.

SAN FRANCISCO, CAL.—Judge Seawell has handed down a decision in the suit of Daniel S. O'Brien against the Sutter Street Railway Company, holding that the company was illegally operating horse cars in Market street. Judge Seawell maintains that the company forfeited its Market street franchise when it stopped its cars at Sutter, in place of running the cars out to the end of the line. The suit was brought to test the right of the company to operate the cars from Sutter street to the ferry.